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HINDRANCES TO THE EXTENSION OF UNIFORM METHODS FOR VITAL STATISTICS IN THE UNITED STATES.

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The persistent worker for an efficient system of vital statistics for the entire United States must necessarily be an optimist. I do not mean to include under this term that class of persons who, as it might be said, "do not know enough to come in when it rains," nor who persist in believing this to be the best of all possible worlds in certain respects, despite rather obtrusive evidence to the contrary. I mean that the laborer for better registration methods must have a large amount of faith on the evidence of things as yet unseen, and must hold fast to each bit of encouragement and success that comes in the extension of better methods of recording births and deaths in this country, without dwelling on the comparatively slow progress, the disheartening indifference and ignorance found even among those who might be presumed to be active friends of better methods, and the almost insuperable difficulty of securing *thorough enforcement* of registration or any other laws in the United States.

My title gives me permission to touch upon the dark side of registration work. I shall try, however, to give due credit even to the obstacles, and first I shall call attention to the fact that the progress of vital statistics in the United States has been more rapid during the past decade, during the past few years, and especially during the present year, than ever before. And a large part of the credit for the movement for uniform and effective legislation, including the adoption of the Model Law and its underlying essential principles first formulated by a committee of this Association, the standard certificate of death, and the rules for statistical practice, is

due to the American Public Health Association and dates more particularly from the meeting held at Denver in 1895.

We are progressing, therefore, and progressing rapidly. In some localities we are perhaps progressing too rapidly, that is to say, more is being undertaken than can be thoroughly and completely carried out. But we are not progressing as rapidly as many would desire, especially those who are entirely uninformed as to the practical difficulties in the way of administering registration laws in the United States as a whole, or even of the deficiencies of registration in their own vicinity. I take as an example of ordinary public opinion an editorial from a daily newspaper which has devoted more than the ordinary amount of helpful attention to the matter of better vital statistics:

"The Fight for the Babies.

"The Children's Bureau, seeking first of all the detailed facts about mortality among children, wants the states to help it by establishing complete systems for getting the facts together. It has estimated, from figures that are kept in eight states, that 800,000 [300,000] children die annually at ages less than one year.

"It is plain enough that if eight states can establish systems under which complete vital statistics may be had, forty others are able to do it, and ought to. The census is not the right authority to handle this work, because it does not maintain a constant touch with the community. But between the cradle and the grave, what with the doctors, the coroner, the undertaker, the insurance folk, the newspapers, the neighbors, and the tax collectors, there are so many authorities on vital affairs standing around that it seems inexcusable that this country should have practically no worthwhile data of this sort. It is merely a matter of imposing requirements and penalties. The states' coöperation must be had, and it seems that this is one matter in which coöperation and uniformity of statutes would commend itself so completely, and the object would be so manifestly desirable, that uniform state laws should be attainable with comparative ease.

"The truth is that there is need for creation of some central agency for the very purpose of promoting coöperation, in matters of this sort, among the states. That none such has ever been established indicates an oversight at a point where practical consideration would have suggested it. It would not be very expensive, and ought to open the way for many useful accomplishments.

"The National Government could well furnish the impetus and the means for initiating such a movement, and, once the states had enlisted themselves, recommendations from the central body would certainly receive attention at the hands of the legislatures."

Easy and simple indeed! I wonder why the idea has occurred to no one to call the attention of the forty states that do not possess complete and satisfactory registration of *births and deaths* to the importance of the subject. Then, it being "merely a matter of imposing requirements and penalties," this is a matter "in which coöperation and *uniformity* of statutes would commend itself so completely, and the object would be so manifestly desirable, that uniform state laws should be attained with comparative ease."

The editorial is instructive because it fairly well represents public opinion on this subject, which does not appreciate the difficulties—due largely to the uninformed public opinion itself—that stand in the way of enforcing complete registration of vital statistics in the United States. Not even eight states—as I showed you in the map—have succeeded in obtaining fairly complete registration of both births and deaths. Not even the city of Washington does this, the laws for which are made directly by Congress. So it is not a mere matter of "imposing requirements and penalties" even in the District of Columbia, let alone states with sparsely settled and perhaps largely illiterate populations. Those of you who know of the growth of the registration area during the past decade, and have been on the fighting line in the work of extension conducted by the Bureau of the Census in coöperation with the American Public Health Association, the American Medical Association, and the authorities of many states, will smile at the suggestion that some new centralizing agency is chiefly necessary. If this were the fact, and if legislatures would adopt laws recommended by governmental authorities and enforce them when adopted, then we could ride at once, "on flowery beds of ease," to perfection in this respect, and the hard work, "lobbying" (if one may apply a term now thoroughly disreputable to the decent advocacy of proper registration laws), together with the disappointment and failure oftentimes encountered in the promotion of such legislation, would be done away with.

First and foremost in the mind of the average reformer is the "passage of a law." It sometimes seems as if this were the cheapest and most effective way to dispose of a proposition of reform. How rarely does thorough enforcement follow the passage of any law! Indeed, if I should be asked what is the greatest, the underlying, the everywhere present, and, so far as our present experience extends, the insuperable difficulty or hindrance to the effective registration of vital statistics in the United States, I might reply: "Contempt of law."

This contempt now permeates the whole mass of the American people. We are coming to despise both laws and the making of laws. Any law of general application that is not enforced uniformly and fairly, without prejudice or favor, and upon all persons alike, is contemptible before the bar of justice. Professor Reinsch in his work on "American Legislatures and

Legislative Methods" states that in five years, 1899 to 1904, the total number of acts passed by American legislatures was 45,552, of which 16,320 were of a public or general character. Of the vast grist of crude, ill-digested, inoperable, and unnecessary laws, how few are enforced at all, or enforced with a fair degree of thoroughness? Many are stillborn from the date of their passage, some encounter the question of "unconstitutionality" on grounds that should have been considered, and avoided, in their preparation, and others become "dead letters" simply because no one has any particular interest in their enforcement or are systematically violated by a peculiar selective process on the part of the officials charged with their administration. A state registrar or a city health officer thus frequently enforces certain laws or certain parts of laws committed to his authority, while he practically disregards other laws or parts of laws that are equally binding and equally dependent upon his faithfulness of execution. Thus we have, practically, an additional law-making body, upon whose discretion—although the *law* may have given no discretion but made enforcement an imperative duty—the actual execution of the law depends.

How many health officers in the United States even make an attempt to *enforce*, by the penalty of the law, failure or neglect to register births? But birth-registration laws are probably about as well enforced as the great generality of laws. When the penalties for the most grave offenses, even murder for example, are not enforced, or enforced in such a small proportion of cases that the probability of the infliction of the penalty prescribed becomes quite negligible, what with appeals from court to court, and all the means of delay and escape with which we are all so familiar, is it likely that comparatively trivial offenses will be punished? In fact they are not, and the enforcement of registration and other laws of similar character has been largely a farce. So common is this condition that the actual thorough *enforcement* of a new excise law in the District of Columbia, with infliction of the penalty of the law in *every* case of violation, has become a sort of nine-days' wonder. Other regulations are subject to spasmodic enforcement. For example, the requirement that all dogs shall be muzzled is at present receiving some attention, several individuals having recently been bitten by rabid dogs; but between such intervals little attention is paid to the provision, and even in times of greatest efficiency probably less than half of the dogs are equipped to comply with the law. Until we reach a higher plane of respect for *law* and the general public demands that all laws shall be carefully considered before enactment and then carried out to the letter, we cannot expect complete registration of births and deaths. An efficient registration law contemplates no deficiencies. Practically every birth and every death *must* be recorded in order to afford reliable statistics and to insure proper legal records for all persons dependent upon them. The provisional basis of 90 per cent., without which no regis-

tration area could have been formed, is merely a makeshift until more effective registration shall yield records that are practically complete.

I have dwelt upon the disregard for law as the principal hindrance in the way of obtaining vital statistics for the United States. Until this can be overcome, and the process of education is necessarily a slow one, we can not expect as complete registration of births and deaths as in those countries in which the first presumption with respect to a law is that it is made to be obeyed, not neglected and disregarded. We must cultivate respect for law and insist upon the enforcement of law, even at times with some hardship to the individual, in view of the greater good that will result to all citizens and to the state from such enforcement. We must become law-abiding instead of law-defying as a nation, and public opinion, without whose support in a democracy the forms of law become merely objects of derision, must be trained to recognize the fundamental importance of vital data and to demand the uniform, thorough, unremitting execution of the measures adopted for securing them.

It may be of interest to mention some of the obstacles that have delayed the progress of uniform registration of vital statistics in the United States:

(1) The American Public Health Association. The American Public Health Association *ought* to be the largest, most influential public health organization in the country, with thousands of trained sanitary workers, each of whom should be firmly convinced, as the Association is most earnestly convinced—theoretically—that vital statistics are the absolutely necessary bases of all modern public health work and that the complete registration of births and deaths *must* be insisted upon as the first and indispensable step in proper sanitary organization. I am not unmindful of the great debt that American vital statistics will always owe to the American Public Health Association, to whose action we are indebted for the general adoption of the International List of Causes of Death, the Model Law for the registration of births and deaths, the Standard Certificate of Death, and the institution of the section on vital statistics with its rules for statistical practice that are doing so much for uniform vital statistics in this country. I only regret that the Association is not larger and that it does not fully occupy the position that it should, in view of its long and honorable history, as *the* great unofficial public health agency of the country, whose directive impulse should be the inspiration and the guide of all the many diverse public health movements that have so multiplied of late. It should be able to *command*, by force of scientific authority, proper provision for its fundamental necessity—adequate registration of vital statistics. As a matter of fact very little aid has been received from the Association in the promotion of recent registration laws. While it is true that a large proportion of the work for the extension of proper registration methods has been undertaken by the American Medical Association, the American Public

Health Association, which began this work, should continue to coöperate actively, and I believe that it would be desirable that a larger proportion of the attention of the general Association, not merely its special section, should be devoted to the subject.

Certainly the members of the Association should be fully informed with respect to the principles and methods recommended by the Association. Some attacks have recently been made upon the Model Bill, and the opportunity of passing a good law for Illinois was lost because a committee, largely composed of sociological authorities, rejected the Model Bill, which was grossly misrepresented to them, in favor of an inferior measure which, probably fortunately on the whole, failed to pass. It was said to them that "The statement of occupation on the Standard Certificate of Death, giving the last occupation, was not only worthless from a statistical standpoint, but it was misleading." You all recall the pains taken by this Association preliminary to the work of revising the standard certificate at Richmond in 1909. If this assertion were true, then its action at that time would be subject to very serious criticism and all the states and cities that have employed the standard certificate would be in a very serious predicament, as well as the Bureau of the Census, which has indorsed it and employed it for all transcripts of deaths, and the American Medical Association, American Bar Association, and other organizations which have incorporated it in the revised Model Law. As a matter of fact the assertion was entirely unfounded. The Association was well advised in not undertaking to complicate the difficult statement of occupation and industry with the double statement of last and former occupation and industry. Careful checking of transcripts based upon a form attempting to collect such additional data with the original certificates showed that the proportion of cases in which the duration of any cause of death stated was greater than that of the last occupation was negligible (about 1 per cent.),* while a very considerable proportion of errors of transcription, largely due to the use of a different form of certificate for the collection of the data and involving changes in the classification of occupation to the extent of over 15 per cent., appeared. Until it is possible to obtain much better statements of both special occupation and industry upon certificates of death, it is absurd to insist upon additional data. The necessity of uniform certificates in order to obtain comparable data is plainly shown. I hope that in time the broad view of national uniformity will outweigh any local preferences. Certainly if the states can not come together in the comparatively simple matter of the adoption of a primary schedule for recording deaths, after full discussion in this representative Association, it would seem hopeless to attempt more difficult measures of uniformity,

*Only a very few of this small percentage were cases that would justify selection of the former occupation.

such as the adoption of standard tables and precise rates. But I hope that further consideration will lead to union and the waiving of individual preferences for the sake of general agreement.

In this connection I am very glad that we now have in the Association a sociological section. I hope that it may soon have a joint session with the section on vital statistics, for I believe, as indicated by the social program of the Southern Sociological Congress, which "stands for the adoption of the uniform law on vital statistics," that the registration of births and deaths, sickness, marriages and divorces, and the thorough analysis of the data thereby obtained, are of the first importance to the correct understanding of our social conditions. I did not intend to refer with any disrespect to the unfortunate action of the Chicago sociologists with respect to the Model Law and the standard certificate; they had no acquaintance with matters of practical vital statistics and very naturally believed statements, even the most absurd, that came with seeming authority. But it is time that all social as well as sanitary workers should become informed on this subject, and association with the registration officials will be beneficial for this purpose while the registration officials will also be able greatly to broaden their views as to the significance and usefulness of the data with which they deal.

(2) State public health officials. While I believe that the subject of vital statistics is today receiving more effective attention from state sanitary officials than ever before, I do not believe that it has yet attained that share of their attention and financial support that its importance demands. In too many states the chief attention of the administration officers is devoted to other subjects, leaving the conduct of the registration work in untrained hands or not giving it a full measure of support when the actual test of *enforcement* of law arises. Sometimes an unnecessary amount of statistical detail is attempted in the compilations while the thorough enforcement of the law in all parts of the state, on which the validity of the data depends, is neglected. A dangerous condition that arises in the extension of the registration area is the too early expectation of results. As Americans, we are prone to the adoption of get-rich-quick methods and look for immediate recognition of the completeness of registration too soon after the adoption of a law. Not even the Model Law can procure complete or approximately complete registration until a reasonable time has elapsed for it to be put into thorough and complete operation over the entire state. In some cases special obstacles occur in administration, owing to the difficult character of the country, insufficient financial support, lack of experience, of registration officials, sparse population, or large percentage of colored or illiterate population; such difficulties must be taken into consideration and state officials should not be discouraged if they cannot at once command success.

(3) City public health officials. The same difficulties arise in city as in state administrations of registration laws. The defects of birth registration are especially noteworthy in the vital statistics of many of our cities because it should be perfectly practicable for municipal health authorities to insist upon and obtain practically complete registration of births. They should certainly insist upon strict compliance with the Rules of Statistical Practice adopted by this Association in the preparation of their annual reports and bulletins, but in a considerable number even of our largest cities those recommendations are neglected. Unfortunately, in too many cases the statistical work in our city offices is in totally unskilled and incapable hands. It should be regarded as of the *first* importance and should be organized as efficiently as the laboratory work or any other part of the city health administration.

(4) The medical profession. Too much credit cannot be given to the physicians of the United States for their devoted work in connection with the passage and enforcement of laws for vital statistics. In recent years much of the increase in the registration area is due to the active coöperation of the American Medical Association, through the efforts of Dr. Frederick R. Green, secretary of its Council on Public Health, which has devoted a large part of its annual meetings to this subject and distributed many thousands of copies of the Model Bill in states where legislation for vital statistics was under consideration. The profession as a whole cordially appreciates and supports the registration of vital statistics, although by the operation of such laws physicians are required to file certificates of birth and to fill out the medical certificates of causes of death, usually without special compensation. The question of payment for such returns is a matter for the consideration of each state, although the committee that revised the Model Bill was for the most part opposed to it. Whether payment is made or not, it is necessary that the law be enforced upon a uniform basis and that all births and deaths be registered. Hence the sentiment of the profession should not only support the installation of vital statistics laws but should insist upon their thorough enforcement, by prosecution of delinquent members of the profession if necessary. Only a small proportion of the physicians, as a rule, would continue to neglect their duty in the face of the general opinion that it was unprofessional conduct to fail to perform the duty to the family, to the state, and to society generally that is implied in the registration of vital statistics.

(5) The legal profession. A large part of the help that is desired from the legal profession would consist in the more thorough consideration of legislation by the lawyers who form such a large proportion of our state legislatures and the moral support of the bar and bench in the effective enforcement of registration laws. The value of such records for important legal and judicial purposes will commend itself at once to those engaged in

the practice of law, and I am very glad to state that the American Bar Association appointed a representative to aid in the recent revision of the Model Bill and that the Committee on Vital and Penal Statistics of the Conference of Commissioners on Uniform State Laws is also actively interested.

(6) Lastly, and most important of all, the interest of the people is not yet sufficiently awakened to the importance of the registration of births and deaths. Most of all do we need the support of the "better half" of the population—the women—and we are just beginning to get it, largely through the interest developed in the work of the recently established Children's Bureau. The work of that bureau is handicapped by the lack of statistics of infant mortality, owing to the absence of thorough birth registration. It was established by Congress for a great and beneficent purpose, the protection of infant and child life, and when the mothers of the country realize that the accurate registration of births and deaths in all parts of the United States is an indispensable means for its full development and successful work, I believe that there will be an irresistible demand that the births of their children shall be recorded. The registration of births has been especially defective in Colorado. Where women's voices and votes are potent in political action should certainly be the beginning of reform in this respect, and I hope that the women of this state will take an active interest in ascertaining the causes and remedying the conditions whereby the registration of births in Colorado has not been complete.

POSSIBILITIES OF REDUCING MORTALITY AT THE HIGHER AGE GROUPS.

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Read before the Section on Vital Statistics, American Public Health Association, Colorado Springs, September, 1913.

Particular interest has been concentrated, during the last decade, on the mortality at the higher age groups. The unfavorable changes which have been observed in the death-rates at these ages are in striking contrast to the conditions at the younger ages, where, during the last fifty years, marked improvements have occurred in both sexes. This contrast has occasioned much comment from sanitarians, the medical profession, and especially from insurance executives, who, as you can well understand, are deeply concerned with the vast possibilities of checking losses from premature mortality. The interest of the community, however, is paramount to all others in view of the great value to it of each adult, not only in economic terms, but also in the larger social aspects which are involved in the serious disturbances to family life resulting from the death of a parent or a wage earner.

A very significant contribution to the discussion of the subject is the report of Dr. Irving Fisher of the Committee of One Hundred on National Health. In this report, Doctor Fisher pointed out that the causes of death which predominate at the higher age groups were preventable to a degree, and that, if the diseases and conditions involved were controlled to the extent of the facilities of modern medicine and sanitary science, there would be added to the expectation of life at least one and one-half years at age 45. This judgment of Doctor Fisher is extremely conservative in view of the fact that his estimates did not include the possible saving from tuberculosis which is a considerable mortality factor at the older ages, and also because he assigned no coefficient of preventability to the various forms of cancer, which, since his writing, have shown a large measure of possible control.

It is impossible at this time to estimate in years and days with any degree of precision what saving in middle life can be accomplished. But it is increasingly evident to competent observers that the attitude taken by Doctor Fisher was more than justified and that the possibilities for human conservation at the present time are much more hopeful than they seemed five years ago. It is the purpose of this paper to consider some of the elements which enter into the mortality saving in the higher age groups

and to show what the possibilities are for the control of the conditions which determine these rates.

Mortality Changes in Ten Years.

I present herewith Table I, which gives the death-rates for males and females for the years 1900 and 1911, respectively, for the registration states as they were constituted in the year 1900. These included Connecticut, District of Columbia, Indiana, Maine, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Rhode Island and Vermont, which states enjoyed good registration conditions at both dates. The figures presented, therefore, are quite comparable for the two periods. Figures earlier than those for 1900 would be most desirable for comparison, but they cannot be obtained.

TABLE I.

COMPARISON OF MORTALITY OF MALES AND FEMALES BY AGE GROUPS. DEATH-RATES PER 1,000 POPULATION.

(Registration States as constituted in 1900.)

Age.	Males.			Females.		
	1900.	1911.	Per Cent. Increase or Decrease.	1900.	1911.	Per Cent. Increase or Decrease.
Under 5	54.2	39.8	−26.57	45.8	33.3	−27.29
5–9	4.7	3.4	−27.66	4.6	3.1	−32.61
10–14	2.9	2.4	−17.24	3.1	2.1	−32.26
15–19	4.9	3.7	−24.49	4.8	3.3	−31.25
20–24	7.0	5.3	−24.29	6.7	4.7	−29.85
25–34	8.3	6.7	−19.28	8.2	6.0	−26.83
35–44	10.8	10.4	− 3.70	9.8	8.3	−15.31
45–54	15.8	16.1	+ 1.90	14.2	12.9	− 9.15
55–64	28.9	30.9	+ 6.92	25.8	26.0	+ 0.78
65–74	59.6	61.6	+ 3.36	53.8	55.1	+ 2.42
75+ and over	146.1	147.4	+ .89	139.5	139.2	− 0.22
All Ages	17.6	15.8	−10.23	16.5	14.0	−15.15

You will observe that, for the males, all age groups up to and including 35–44 show decreases in the mortality rates for 1911 in comparison with those for 1900, the percentages of decrease ranging from 27.66 for the age group 5–9 to 3.70 at the age group 35–44. From this age group onward, the rates for 1911 are persistently higher than for the earlier

date, the largest difference being at age period 55–64 when the percentage of increase reaches 6.92. For females, the decreases in the mortality rates extend up to the period 45–54, inclusive, the decreases varying from 32.61 per cent. at the age group 5–9 to 9.15 per cent. at the age group 45–54. The ages 55–74 show a slight increase and above 75 the rates for the two periods are virtually identical. It is evident, therefore, that at all ages, the mortality has been much more favorable for the females than for the males, but, in both sexes, the various forces which have been at work to reduce mortality, suddenly lose their effectiveness during the period of middle life at which time an actual deterioration occurs. Above age 75, no significant changes have taken place and we are not much concerned with a problem of "old-age" mortality.

The Increased Frequency of Certain Causes of Death.

It is necessary, therefore, in our analysis to concentrate attention on the diseases and conditions which cause the larger part of the mortality at the advanced ages. These include cancer, diabetes, apoplexy, organic heart disease, diseases of the arteries, cirrhosis of the liver and Bright's disease. The least median age at death of this group is about 55 years. Together, they form 51.2 per cent. of all deaths at age 40 and over, in the industrial mortality experience of the Metropolitan Life Insurance Company during 1911. The corresponding percentage in the Registration Area is 51.4.

Table II shows the rate per 100,000 for each one of these causes for the years 1900 and 1910, respectively, in the Registration States as constituted in 1900.

TABLE II.

DEATH-RATE PER 100,000 OF POPULATION FOR CERTAIN CAUSES OF DEATH—MALE AND FEMALE COMBINED.

(Registration States as constituted in 1900.)

Cause of Death.	1900.	1910.	Per Cent. Increase.
1. Cancer (all forms)	63.5	82.9	30.6
2. Diabetes	11.0	17.6	60.0
3. Cerebral hemorrhage and apoplexy	72.5	86.1	18.8
4. Organic diseases of the heart	116.0	161.6	39.3
5. Diseases of arteries	5.2	25.8	396.2
6. Cirrhosis of liver	12.6	14.4	14.3
7. Bright's disease	81.0	95.7	18.1
Total	361.8	484.1	33.8

It is evident from this array that the rate per 100,000 has increased considerably in all of the causes mentioned, the rate for the seven diseases combined being 33.8 per cent. higher for 1910 than for 1900. The largest increases are to be observed for the circulatory diseases, namely, the diseases of the arteries and organic heart diseases, the former having increased close to fourfold in the ten years. Similar conditions have been noted by registration officials throughout this country and in foreign lands and it may safely be said that the increased frequency in the degenerative diseases pointed out above represents a distinct tendency in modern life which is worthy of the most searching attention.

We will now proceed to discuss the factors which, we believe, are in a large measure responsible for the conditions observed. In general, it is clear that we must look to the conditions of life in the earlier ages for an explanation. The organism at fifty is little more than what the preceding years have made it. The hereditary factor, or the so-called physical endowment of birth, must, to be sure, be considered; but, at this advanced age, its importance is largely overshadowed by direct influences of environment which have continuously modified the physique. We shall consider this early environmental influence under three heads, namely,

(a) The occurrences of disease in childhood and early adult life.

(b) Habits and modes of life, including especially such as constitute what insurance men call the "moral hazards," and

(c) The effects of occupation.

The Effect of the Communicable Diseases on Mortality.

In the first place, such diseases as organic heart disease and Bright's disease, which are exceedingly prevalent at the advanced ages, are often the sequelæ to diseases occurring previously, namely, the acute infections of early life. I need only refer here to the many cases where scarlet fever, diphtheria, acute articular rheumatism or typhoid fever have left the patient impaired, either in the circulatory or in the renal systems. Medical literature is replete with incidences of chronic nephritis which have followed in the trail of scarlet fever and of heart and vascular lesions which had their origin in typhoid fever and acute articular rheumatism. These impairments often go unnoticed until, under the stress of middle life they terminate in one or another of the degenerative diseases which we have just considered. In such cases, the initial cause is usually not indicated on the death certificate and it is, therefore, not possible for the statistician to evaluate the importance of this factor. That it is significant, however will, I believe, remain unquestioned.

This view of the effect of the acute infections must not be confused with that of other students who, in their discussion of the mortality conditions at the higher ages have assumed that the acute diseases serve as a sort of

filter for the elimination of weaklings who would not ordinarily reach a ripe old age. These writers have asserted that the decreased incidence of these diseases during the last two decades has diminished the force of natural selection against the weaker stock and that, as a result, the mortality at the higher ages has been correspondingly increased. I believe that the weight of the emphasis should be placed at the other end of the beam. Whatever may be the increase assigned to the element which they point out, the direct results of the infections that occur in early life, and which leave serious impairments in heart and kidney, must be much more significant. We must, therefore, concentrate more and more attention upon the elimination of the communicable diseases of early life in order to reduce the mortality at the higher ages. In the future, the rate from such diseases as organic heart disease and Bright's disease will serve as an additional measure of the efficiency of present-day control of the communicable diseases of childhood and youth.

The Effect of Venereal Disease and Alcohol.

Secondly, the habits and modes of life have their effect upon the mortality at the later ages. Details of personal hygiene, such as a rational diet, a reasonable amount of exercise, regular bathing and those subtle refinements of mental hygiene, which are designed to conserve nervous force, are of great significance. Most important, however, for our discussion, are the effects of the venereal diseases and of the intemperate use of alcoholic beverages.

The earlier incidences of gonococcus infection and syphilis have a decided effect upon the mortality at the later ages from the serious circulatory, nervous and genito-urinary diseases which they induce. In the male, gonorrhœa often develops serious involvements of the vascular system and, in the female, we observe such complex pelvic disturbances as are responsible in so large a degree for many of the operations which result in a significant part of the female mortality over age 45. Syphilis affects the nervous and circulatory systems, ultimately giving rise to circulatory and spinal lesions, which terminate in conditions reported as "locomotor ataxia," "cerebral hemorrhage," "paralysis" and the various types of mental alienation. We have the authority of Osler that in nearly 90 per cent. of the locomotor ataxia cases, we find a syphilitic personal history. There are no similar figures available for the other degenerative diseases, but syphilis surely plays a prominent part in providing the initial changes which terminate in the causes mentioned. Health officers should, therefore, give their active support to all movements which are directed at the control of the venereal infections.

The effects of the intemperate use of alcohol upon middle age mortality are closely related to those of the venereal diseases; indeed, there seems to be a distinct correlation between these two forms of indulgence. The

statistical analysis of the subject is full of difficulties in view of the reticence of physicians to report the facts of alcoholism on the death certificate. Yet the evidence is unmistakable that there is a marked influence on middle- and old-age mortality from this cause. The title "Alcoholism" (acute and chronic) in the census returns showed, in 1911, the not very significant rate of 4.9 per 100,000; but this is only a trace of the deaths resulting from alcoholism. No one can estimate the annual mortality loss that is hidden behind such returns as "pneumonia," "acute and chronic nephritis," "cirrhosis of the liver," "organic heart disease" and "arteriosclerosis," all of which causes are now, as we observed, on the increase in their incidence at the higher ages. If further evidence of the causal relation between alcoholism and higher mortality were necessary, we should need only refer to the body of facts which have been accumulating in insurance offices showing that total abstainers are by far the best risks and that the mortality rates observed in various occupations are significantly tinged by the degree of exposure to alcohol which is characteristic of the occupation.

We cannot, therefore, observe without alarm the reports of the steadily increasing consumption of alcoholic beverages in the United States during the last thirty years as shown by the reports of the Commissioner of Internal Revenue. In the period 1881–90, the per capita consumption of liquors and wines was 13.21 gallons, whereas in 1912 the figure per capita had risen to 21.98 gallons, an increase of 66.4 per cent. since the earlier date. In this changed condition, almost the sole contributing factor has been the consumption of malt liquors. We are becoming, as a nation, too free in the use of alcohol, and it is high time that the lesson which Germany has apparently learnt and is taking to heart, as is shown by the reductions in the consumption of alcoholic beverages recently observed in that country, were applied among us before further damage is done.

The Effect of Occupation.

Third, and most important, in our discussion of the factors contributing to middle age mortality, are the effects upon the body of the habits and conditions of work. This is what we may call the occupation factor. We are all familiar with the picturesque example of the modern business man who is supposed to work at white heat and under great pressure and who, as a result, presents long before due time the classic picture of the broken-down human machine suffering from the whole gamut of the degenerative diseases. The sanatoria and watering places of Europe annually reap their harvest from this product of American commercial life. But we cannot be much concerned with this small group in our discussion. They do not modify our death-rates materially which are determined rather by the conditions of life and work prevailing among the industrial classes of the country. We must, therefore, turn to this much larger group, who, unfortunately, have not received sufficient attention from medical men, in their search for the factors of occupational stress.

The character of American industry has completely changed in the last fifty years. Formerly, most work was conducted in the manner of the hand trades; today, there is evident all along the line a specialization of industry which brings together under one roof large numbers of workers, each one performing some small and distinctive part of the total process. This condition may be best exemplified, perhaps, by the changes that have occurred in the manufacture of shoes. Only a few generations ago the entire process of shoemaking was in the hands of individual workmen each one of whom performed every operation in the process of making a shoe. Today, in cities like Brockton and Lynn, there are immense establishments where shoes are made entirely by machine processes directed by specialist workmen who perform at high speed and over long hours, one or at most a few operations in the production of a shoe. What is true of shoemaking is characteristic of other large industries.

This specialization has not been carried to its present degree of perfection without having left its mark upon the individual workman. He no longer enjoys the pleasure incident to the performance of a whole task. The unceasing whirl of high-speed machinery, the persistent noises of the shop and the necessary nervous accommodation to the rapid movements of the machines result, after long periods of time, in distinct psychoses. Our vital statistics are not as yet sufficiently refined to indicate the precise effects of these nervous conditions upon the health of the worker and we can, at present, only speculate upon the importance of this factor. There are, however, sufficient suggestions from physiology and pathology that these vague derangements of the nervous system, due to speeding-up processes and to the general maladjustment of individuals to their work, may result ultimately in distinct lesions of the heart and kidney. Many cases of tuberculosis and other serious affections of early life may be traced to the lowering of normal vitality which follows occupational stress. It is our contention that this element also plays a large and hitherto unsuspected rôle in the causation of the diseases of later life. I urge for serious consideration a study of this phase of occupational hygiene.

Apart from these subjective changes which, we believe, have occurred as a result of the specialization of industry, we must consider those objective phases of occupation which are inseparable from present-day working conditions. The presence of large numbers of workmen under one roof brings about new and distinct problems of hygiene in industry. The large shop at once raises the question of the purity of the air supply, its temperature and humidity, the adequacy of natural and artificial light, the provision of lavatories and other sanitary facilities, together with a host of minor details which in their entirety markedly affect the health condition of the individual workman. The effects of high temperatures and humidity upon the health and longevity of workpeople are best illustrated by the disheartening conditions revealed by Perry in his monograph on the cotton-

mill operatives. The extreme variations in temperature, as observed in the steel mills, have long been known for their disastrous effects upon the workmen engaged therein, especially with regard to the high incidences of rheumatism and pneumonia, both of which play a prominent part in middle-life mortality.

We must also consider the factors of dusts, fumes and poisons which play a significant part in present day occupational mortality. The dusts, especially those of metallic or mineral origin are well known for their effects upon the respiratory system. We should remember in this connection that many who become incapacitated for continued work at the dusty trades often enter other and lighter work, dropping thus in the scale of economic efficiency and later succumb to other conditions of middle life. The fumes and poisons, especially those which arise in the refining and handling of lead, copper and arsenic, in like manner, cripple thousands early in life, throwing them on other industries for indifferent employment and support. Middle-age mortality returns, as they come into our statistical laboratory for study, are loaded with indications of occupational poisonings of one sort or another in early life. In no other way can we explain the large incidence of the degenerative diseases in those cases of apparently negative occupations at death, which on further inquiry reveal the previous employment in trades like that of the painter, compositor, or laborer in paint, rubber and color works.

Measures of Control.

This high mortality of middle life is thus largely a resultant of our occupational conditions. What measures may we then employ in our attempts at relief? Essentially our future endeavors will, we believe, take the following directions:

1. The further development of that type of efficiency engineering which will result not alone in economies of production but in such economies of human effort which will conserve the health and life of the individual workman. The first viewpoint is that of the industry, while the second is essentially that of society as a whole. This program will take into account the radical improvement of the conditions of work such as the hours of labor, the sufficiency of light, the purity of air, and the maintenance of a favorable temperature and humidity in the shop. This will involve the enactment and enforcement of far-sighted labor legislation. Such efforts will amply repay employers and the state for the additional expense involved in increased product on the one hand and in the extension of the span of life on the other.

2. The medical examination of workmen, both at the time of their entrance into the industry and periodically thereafter. A medical examination will often discover the presence of the organic diseases which we have been discussing and will encourage the early application of remedial measures. Many instances of this kind of enlightened management are

already in evidence. The North Company of Worcester, Mass., during the past year has instituted the physical examination of its twelve hundred employees. Persons, suffering from physical defects, are informed of the fact and are advised to secure proper treatment. In some cases, where the nature of the work has tended to aggravate the condition, a change of occupation is arranged. An extension of this programme should be recommended by health officers and social workers to the managers of industrial establishments. In this way the community will receive the benefit of a comparatively inexpensive and most effective measure for life conservation.

3. The education of workmen and employers in the essentials of occupational hygiene. By means of lectures delivered in the factory and before trade organizations, workmen can readily receive instruction which would result in the prevention of diseases and accidents. Pamphlets should also be widely distributed. No programme of conservation in industry can be thoroughly successful unless it has the active coöperation of the workmen themselves.

4. The close study by officers of the departments of health and labor of death certificates to discover whether proper preventive measures had been taken to prevent the death when it is suspected that industrial conditions were at bottom responsible for the disease or condition reported. In this way, we shall be able to determine what industries are contributing, abnormally, deaths from preventable accidents, from poisonings and from other important occupational causes. Health and labor officials should determine in each instance whether the labor laws had been complied with, and see that the guilty persons are prosecuted for violations. This programme is carried out fully in Great Britain by the medical officers of health of each district.

Diabetes and Cancer.

Two diseases, diabetes and cancer, which play an important part in the mortality at the higher ages, still remain for our brief consideration. While the definitive causes of both diseases are still obscure, considerable progress has been made recently in our therapeutic control of them. Research directed in the field of the chemistry of metabolism has done much toward checking the course of diabetes, especially in early cases. We may expect results from the clearer realization that many cases of the disease have their onset in the metabolic disturbances which follow tubercular and traumatic conditions. It will be the particular function of the periodical medical examination of workers to discover incipient cases of this disease, a large number of which, at the outset, can readily be managed.

The cancer situation is much more involved. The increase in the mortality rate from cancer has been very decisive, but there are indications that the rate has probably reached its high-water mark. Altogether, the outlook for its control was never brighter than at the present time. Not only are the recent contributions of the research laboratories to the pathology and etiology of cancer most encouraging, but progress is also reported

in the surgical and ray treatment of the disease. Great promise, moreover, is held out by the campaign of popular education which is in full swing on all sides. The aroused interest of the public and the better and earlier diagnoses by physicians will lead to the discovery of many cases in the early stages and will present them for surgical treatment. More especially should efforts be concentrated upon the education of women in the practice of consulting the physician or surgeon upon the merest suspicion of the appearance of cancer of the female genital organs. Even at this time, most cases come to the operating table all too late. It is against the fatal policy of delay that the efforts of most public bodies interested in the problem should be directed.

In conclusion, we should add a few words of commendation for the movements which have recently developed for the better care of persons in middle life, afflicted with functional disturbances of the heart and kidney. The proper care of these cases, with reference to choice of occupation, will lead often to the prolongation of life. Many of those afflicted can participate without much injury to themselves in gainful occupations if properly directed, where without such guidance they soon overtax their limited energies and become unfit for any work. It should be kept in mind, however, that such a policy useful as it undoubtedly is, will have ultimately, the effect of increasing our mortality at the older ages. Such an increase should not be looked upon with any apprehension since it is quite normal and involves no social loss.

Summary.

We may now summarize our discussion of the factors which enter into the possible reduction of mortality at the middle ages as follows:

1. We must place even greater emphasis upon the municipal control of the communicable diseases of early life in order to reduce the instances of heart and kidney impairments which often result therefrom.

2. We must encourage the movements directed against the spread of venereal disease as well as against the intemperate use of alcoholic beverages.

3. We must further all efforts for the improvement of adequate labor legislation and promote better understanding between employers and employees. This programme will include the improvement of factory sanitation, the medical examination of employees and the instruction of both employers and employees in industrial hygiene.

4. It will be necessary to supplement labor legislation with the careful examination of death certificates to see that in every instance those who are responsible for preventable deaths are properly prosecuted.

5. Finally, we must heartily encourage the movement for public education on all topics connected with personal hygiene that there may be better coöperation between physicians and their patients and that there may be no unnecessary losses sustained through neglect of symptoms pointing to serious organic diseases.

SANITARY CONDITIONS IN HAWAII.

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GENERAL CONSIDERATIONS.

The Hawaiian Islands are very appropriately designated "The Cross Roads of the Pacific." The group consists of seven inhabitated islands lying almost directly in the line of travel from the western coast of North America to the Orient. Commercial relations and the exigencies of steamer traffic make Honolulu, the chief city of the archipelago, a port of call for vessels engaged in trade between the Far East and North and South America. Most of these vessels stop at Honolulu twice on each round trip. These considerations, while contributing to the commercial prosperity of the country, add to the complexity of its public health problems.

In addition to the ordinary commerce with other countries the immigration problem is vastly more important here than elsewhere. The labor supply in the Islands is totally inadequate to furnish all the help required by the various industries, chiefly sugar growing, and as a consequence it is necessary to import large numbers of foreigners. Formerly these people came almost exclusively from the Orient, but in recent years many have been brought from Europe, especially from Russia, Spain, and Portugal. Many of these men bring their families with them. A single steamer may bring a number of immigrants almost equal to 1 per cent. of the total population of the Islands.

RELATION TO GENERAL GOVERNMENT.

The Island of Oahu, on which the city of Honolulu is situated, is one of the most important *military and naval bases* in the possession of the United States. In the neighborhood of five thousand United States Troops are stationed here at the present time and it is quite likely that within the next few years the number will be largely increased. It is obvious therefore that the Federal Government will always have a very great interest in the sanitary conditions of the Islands. This is recognized by the Territorial Government as well as by those charged with the responsibility of caring for the public health interests of the Federal Government. At the request of the Territorial authorities an officer of the United States Public Health Service was detailed for duty as sanitary adviser to the Governor of Hawaii. It must not be inferred from this assignment that the Territorial health authorities are not efficient and energetic. The very reverse is true. The writer is not acquainted with any state having a more effective health department than that of Hawaii. It was felt, however, that on account of the importance to the United States of the sanitary conditions in the Islands it would be well to have the assistance of an officer detailed by the Federal Government. This is particularly appropriate inasmuch as Hawaii being a Territory and not a sovereign state is, in a sense, a ward of

* Detailed as sanitary adviser to the Governor of Hawaii.

the general government. The intimate relation between Washington and Hawaii is shown by the fact that the Governor of the Territory is a Federal officer appointed by the President, not elected by the people as in the case of a state. In many other ways the affairs of the Territory are subject to supervision at Washington.

Local Conditions.

The scattering of the population over the five Islands (two have such a small number of inhabitants that they may be ignored here), and consequently the comparatively small amount of communication between the various groups of people assists in the task of limiting any outbreak of a communicable disease. At the same time it makes difficult the transference of executive officials of the health department from one point to another.

A very large proportion of the population, perhaps half, live on sugar plantations. From a sanitary point of view, this is probably advantageous as the owners of the plantations have been educated by the Territorial Health Department to see that it is to their advantage to have the health conditions as good as they can be made. Furthermore, it is usually easier to deal with an intelligent, if somewhat obstinate, representative of a wealthy corporation rather than with a thousand individuals, the majority of whom are mentally incapable of appreciating the importance of sanitary precautions as well as being financially unable to carry out even relatively inexpensive measures.

The population of the Islands* is 191,909, made up of the following nationalities:

Japanese	79,663
Hawaiians	26,099
Portuguese	22,294
Chinese	21,698
Part-Hawaiian	12,485
Porto Ricans	4,828
Spanish	1,962
Other Caucasians	14,684
All others (including several thousand Filipinos)	8,196

This heterogeneous population, while on the average more amenable to discipline than an equal number of whites and, therefore, presenting fewer cases willing and anxious to indulge in litigation whenever the opportunity offers itself, is made up largely of people who do not willingly and readily come up to our ideals of cleanliness and orderliness.

The climatic conditions of the Islands leave little to be desired. They probably have no unfavorable influence on the sanitary problems of the Territory.

*Census of 1910. At the present time the population is probably over 200,000.

The water supplies which in general are satisfactory are usually furnished by artesian wells, surface water collected from uninhabited water sheds, and rain water collected from roofs. There has been at least one serious outbreak of typhoid fever due to surface contamination reaching an artesian well.

The only article in the food supply that needs to be mentioned in this connection is *poi*, the national dish of the native Hawaiians. This substance is made from the tuberous root of the taro plant (*Colocasia antiquorum*). The root is washed, steamed, the skin removed by scraping, and the pulp pounded with a pestle until it has a doughy consistency. The mass is then usually kneaded by hand though in some factories this work is done by machinery. No further preparation is necessary except thinning with water. The poi is usually eaten from the fingers. Infection might be transferred from a "carrier" by hand kneaded poi, and a considerable number of persons infected with diseases like typhoid fever or cholera in the same manner as milk may convey them. The same thing may happen when the common poi bowl is employed, as is the case in many native families. Comparatively recently the health department has been given supervision over the poi shops and by means of medical inspection of the personnel an effort is made to obviate dangers that appear inherent to the industry.

Health Department.

The Territorial Health Department is organized along the lines of a strongly centralized state administration. The local governments (counties) have control of such matters as markets, housing regulations, etc., but everything relating to infectious diseases comes directly under the Territorial Board of Health; indeed this body is the only effective health organization in the Islands. In a community, the total population of which is only about 200,000, there is no necessity for a division of authority and it is clear to the writer that the health functions now exercised by the counties should be directly under the Territorial Board. The President and other members hold office at the pleasure of the Governor. The President is the executive officer of the board and has direct control of all administrative matters. Sanitary inspectors cover practically the whole of the Territory. In some cases as on the sugar plantations the inspector is paid by the corporation whose sanitary conditions he supervises. This is obviously an undesirable arrangement but it is the only practicable one with the funds available. It would be better to have all of the inspectors paid by the Territory.

Government Physicians: The Islands have been divided into twenty-five districts with a Government Physician in charge of each. The duty of these officers of the health department is to look after sanitary matters

in general, to conduct medical inspection of schools, report sickness, deaths, and births, and to render needed aid to the indigent poor. These physicians are paid monthly salaries ranging from $25 to $150. It is needless to say that thus subsidizing practically every physician on the Islands outside of the cities results in a very prompt notification of contagious diseases and in every way aids in carrying along sanitary work.

The entire personnel of the health department should be put under civil service rules that would permit of appointments for merit only, and dismissals for adequate causes alone. This should apply not only to subordinates but to the higher authorities in the department as well. There is no such plethora of capable sanitarians for important administrative positions in a community the size of Hawaii that makes it possible to secure the men these positions require every time there is a change of administration. One of the needs of the department is the establishment of adequate bacteriological laboratories on the different Islands.

Special Problems.

Camp Sanitation: The great sugar estates present most important sanitary problems on account of the collection in camps of large numbers of laborers. The term camp in this instance is rather misleading as it is usually understood to mean an aggregation of temporary shelters, but here it refers to the collections of relatively permanent structures, usually wood, in which the unskilled help of the plantation lives. The board of health has devoted particular attention to the problem of doing away with the old-fashioned type of barracks building that was used to house a large number of laborers and their families and has substituted cottages for individual families or for groups of four or five single men. Much progress has been made along these lines and on practically all plantations work is going forward, which will eventually make the camps in this respect entirely satisfactory from a sanitary point of view. A serious obstacle to all improvements is the indifference and even active antagonism of the very class of people that it is designed particularly to help—the laborers. The majority are Orientals (Japanese, Chinese, Koreans, Filipinos) and Porto Ricans. In general they are quite unwilling to do anything to help themselves and, indeed, they even refuse to avail themselves of the advantages given them; thus it is no uncommon thing to find all windows and doors of their houses tightly closed, and in some cases the trouble is taken to exlude light by pasting paper over the windows or hanging cloth over them. Evidently education is needed here about the value of ventilation and cleanliness.

The water supply of almost all of the camps is from artesian wells or mountain streams and is excellent in quality and abundant in quantity. The disposal of waste water is often very difficult. It is frequently used to irrigate sugar-cane fields. In a number of cases the camps are located on land so nearly level that it is difficult to dispose of the waste water.

The installation of well-made concrete drains will usually solve this problem. The disposal of human excreta is particularly difficult on many of the plantations. Dry earth closets and cess pools when used by the class of persons chiefly employed on the plantations rapidly become almost indescribably filthy. Through the efforts of the president of the board of health experiments are being made in the use of the Stiles tank. Just how satisfactory this will prove under the existing conditions is impossible to determine now. The only perfectly satisfactory solution of this problem would be to install adequate sewer systems carrying the waste matter to the sea. The principal difficulty would be the very great expense involved. On some of the plantations there are as many as twenty permanent camps and frequently they are so located that a separate sewer line would have to be carried from each one.

One of the most important of the special sanitary problems is the filling of swamp land in proximity to the larger communities. This is being carried forward at present.

A problem not common elsewhere is that of *wet agriculture*. Much of the land in Honolulu and in Hilo, the largest and second largest cities in the archipelago, is utilized for the growing of rice and taro, crops that require periodic or constant flooding of the land. The chief objection to this is that splendid opportunities are offered for the breeding of mosquitoes. In taro patches this can be obviated by keeping the ponds free from grass and weeds and stocking them with larvæ-destroying fish, but in the case of rice lands no effective solution is at hand. On account of the large investments in these industries it is impossible to abolish them at present.

The Sanitary Commission of Honolulu, an organization authorized by the Territorial Legislature and appointed by the Governor, recommended that a license be required for the growing of these crops and that the following conditions be enforced:

1. A description of the land, giving the area in square feet.

2. That the boundaries shall be at least 50 feet from any building.

3. That during the term of the license no building shall exist on the property described.

4. That the land shall not be used for human habitation or any other purpose than wet agriculture without securing a cancellation of the license, and without first abandoning the wet agriculture proposed.

5. Any violation shall, upon conviction, be heavily penalized.

Infectious Diseases: Diphtheria, scarlet fever, typhoid fever, and the other ordinary acute infections are met with from time to time and handled in a thoroughly approved fashion.

While it cannot be said that there are any prevailing diseases in the Islands in the usual acceptance of the term, there are certain special problems that merit consideration.

Cholera: The Islands have been visited by cholera on several occasions,

the most recent being in the early part of 1911. By prompt and vigorous measures the disease was confined to Honolulu and suppressed with a total of thirty-nine cases, twenty-nine of which were fatal. The exact manner of introduction of the disease was not traced but there was strong evidence that it was propagated, at least in large part, through taro and poi.

Plague: Plague appeared first in 1899. Since then it has prevailed at one time or another on practically all of the Islands. There has been no difficulty in suppressing it save in Honolulu where it has reappeared from time to time up to about two years ago, and on the northern coast of Hawaii, the largest island of the group. Plague rats have been found frequently in the latter section during the past few years and at present the infection extends for perhaps twenty miles along the coast. The rodents that live in the sugar-cane fields are known to harbor the disease and it seems not unlikely that the problem of destroying them will be of the same nature but of less magnitude than the one presented in California in squirrel eradication on account of plague infection. It is believed that an adequate solution of the problem will not be reached until the work of rodent destruction is undertaken by the Territory and Nation jointly in the same manner as on the mainland. In this connection the fact should be mentioned that rodent extermination in Hawaii is a very much more difficult undertaking than in the United States. In Hawaii the large majority of the rats are *Mus rattus* and *Mus alexandrinus*, species that live in trees, under roofs, in stone fences, in rock piles, and in sugar-cane fields. These rodents are much harder to trap and poison than are the ordinary gray rats, *Mus norvegicus*, of temperate climates.

The rat campaign in Honolulu is under the direction of the United States Public Health Service, though the expense is born chiefly by the Territory.

Yellow Fever: This disease has been discovered at quarantine on several occasions and in November, 1911, a case occurred in Honolulu, the infection having been acquired on a steamer from Central and South American ports. Ample funds and the necessary authority being provided immediately, a comprehensive anti-mosquito campaign was carried on. No further cases occurred. The incident, however, led to measures for a continuance of a sufficient mosquito inspection force to keep Honolulu yellow fever proof.

While the *Stegomyia calopus*, the known yellow fever carrier, is sufficiently common in the Islands it is far exceeded in number by *S. scutellaris*, a closely related insect whose breeding places are less restricted than those of *S. calopus*. It is not known that *S. scutellaris* is a yellow fever carrier but judging by analogy it should at least be held under suspicion.

Fortunately, thus far, the Islands have *no malaria problem* as Anophelines are not found and appropriate measures have been taken to prevent their introduction.

Leprosy: For at least fifty years the Islands have carried a heavy eco-

nomic, social, and financial burden in the scourge of leprosy. The policy of segregation has been carried out with more or less vigor since shortly after the presence of the disease was recognized. A few years ago a new law was enacted in which greater stress was laid upon treatment than upon segregation. This law is now working satisfactorily but it is doubted if it can solve the problem. Perhaps the greatest difficulty is in not seeing the cases in time to make an early diagnosis of the disease. Many of the afflicted ones who come under observation would pass muster anywhere in the ordinary intercourse of life as well persons. It is doubtful whether anything short of periodical physical examinations of the population will accomplish the desired end—early isolation of every leper. Although the utmost consideration is shown in dealing with these unfortunates and the most comfortable surroundings are provided for them there is a natural objection to having family ties broken and the patients isolated. That cases of leprosy are concealed long after the nature of the disease is known is admitted by all who are acquainted with the problem.

The writer is disposed to believe that if isolation was made somewhat less of a hardship by having a lazaretto on each island instead of sending all lepers to the settlement on the Island of Molokai, cases would be received sooner and the whole leprosy problem made easier of solution. There is a very general impression that the Island of Molokai is given over entirely for use as a leper colony while the fact is that only one small peninsula is so utilized. The isolation is perfect and on the whole the settlement is in every way excellently well suited for the purpose.

The scientific study of the disease is carried on at the United States Leprosy Investigation Station, which has laboratories both at Honolulu, where incipient cases come under observation, and at the Molokai settlement where the more advanced cases are to be found.

Conclusion: There has been some agitation in Honolulu looking to the transference of authority from the hands of the Territorial legislature to those of a commission directly representing the United States Government. This is held to be logical on account of the importance of the Islands, or at least of the Island of Oahu, as a naval base. It has been asserted by some that the Territorial legislature is incompetent and extravagant and that a government in which the responsibility was centered in officials appointed by the President would be better suited to the conditions that exist here which are admitted to be very different from those obtaining in the United States proper. The writer is, however, of the opinion that upon the whole the local government would not suffer greatly by comparison with those on the mainland. The health department certainly fares better than do those of most communities. I do not know that a sanitarian has any serious complaint to make of a legislative body that votes 20 per cent. of its total revenue to the health department. It can scarcely be regarded as lacking in interest in sanitary matters.

The writer is indebted to Dr. J. S. B. Pratt, president of the Territorial Board of Health, for much data employed in the preparation of this paper.

AN EPIDEMIOLOGIC SURVEY OF ALL TYPHOID FEVER CASES REPORTED TO THE CINCINNATI HEALTH DEPARTMENT DURING THE YEAR 1912.

WILLIAM H. PETERS, M. D.,
Chief Medical Inspector and Assistant Health Officer.

The principal object of the survey was to determine and eliminate the sources of infection; to ascertain as nearly as possible, the number of cases which must be credited to the various etiologic factors; to see what proportion of the cases might cast a suspicion upon the city water supply.

It was impossible to study all of the reported cases in clinical detail but we have been satisfied from clinical histories obtained and agglutination reactions that some of the cases were reported under mistaken diagnoses and should not have been placed on the records as cases of typhoid fever. On the other hand *we believe that many cases of typhoid fever were not reported in accordance with the state law for it is unreasonable to suppose that with the general mild character of the cases and the small number of deaths, the percentage of mortality should be so high.* From the standpoint of prophylaxis the unreported, and consequently uninvestigated, cases are of course of more importance than cases erroneously reported as typhoid fever.

One hundred and eighty-seven cases were investigated and the findings were as follows:

Typhoid fever	175
Other conditions	12

WIDAL.

	Positive.	Negative.	Not made.
Imported cases and temporary absence	50	4	12
Irregular water supplies	19	2	9
Personal contact	9	0	2
Premises not sewered	11	5	5
Mistaken diagnoses	0	8	4
Source of infection not established	24	8	15
Total	113	27	47
Per cent	60.4	14.4	25.2

For diagnostic purposes the Widal test was made in every instance where it was possible to obtain permission from the family physician and patient to puncture the ear.

In the study of our cases the following blank form was used and all facts called for by this form were carefully collected by Miss Body of the Visiting Nurses Association. I am indebted to her for the valuable assistance she has given; I am also under obligation to the doctors of the city for their coöperation and the information which they furnished.

Many of the specimens sent in by physicians were taken too early to give a positive reaction. We were in hopes that the doctors would send in a second specimen. These cases were not followed up by Miss Body for fear that our intentions might be misconstrued.

Age in years.		*Age in years.*	
0– 4	8	45–49	7
5– 9	20	50–54	2
10–14	29	55–59	0
15–19	32	60–64	2
20–24	34	65–69	0
25–29	17	70–75	1
30–34	14	Unknown	1
35–39	11		—
40–44	9	Total	187

The youngest person affected was eighteen months old and the oldest, seventy-two years.

By decades, 28 of the persons reported were under ten years of age; 61 between ten and twenty; 51 between twenty and thirty; 25 between thirty and forty; 16 between forty and fifty, and 5 over fifty. In one instance we were unable to ascertain the age.

	Sex and Race.			
	Male.	Female.	Caucasian.	Ethiopian.
Imported cases and temporary absence	33	33	63	3
Irregular water supplies	21	9	30	0
Personal contact	6	5	11	0
Premises not sewered	12	9	21	0
Mistaken diagnoses	7	5	10	2*
Source of infection not established	21	26	45	2
Total	100	87	880	7

TABLE GIVING CASES AND DEATHS FROM TYPHOID FEVER IN CINCINNATI, OHIO.

From 1900 to 1912 (both inclusive).

	1900.		1901.		1902.		1903.		1904.		1905.	
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
January	17	3	114	29	96	16	103	18	388	49	98	15
February	13	3	47	14	80	19	96	26	117	31	67	13
March	23	7	28	13	114	16	71	15	69	20	74	20
April	14	13	28	12	49	21	54	17	46	18	48	12
May	11	5	31	11	36	11	48	6	65	15	48	12
June	13	6	47	7	51	10	43	6	94	20	46	9
July	9	6	36	16	81	13	49	10	256	33	60	12
August	51	14	82	13	104	22	64	7	200	16	46	14
September	25	11	48	12	152	17	32	6	87	17	55	13
October	45	8	59	14	73	23	25	6	97	13	55	7
November	40	10	54	7	91	16	33	9	109	15	38	9
December	261	33	155	32	111	22	132	18	118	23	111	19
Total	522	119	729	180	1,038	206	710	144	1,646	270	746	155

	1906.		1907.		1908.		1909.		1910.		1911.		1912.	
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
January	92	22	211	24	17	3	9	2	8	2	15	3	14	1
February	86	19	199	16	21	8	12	8	5	1	9	3	6	2
March	72	17	185	24	19	9	10	6	5	1	11	3	18	1
April	78	17	117	11	7	4	6	6	9	1	9	1	6	5
May	106	11	99	8	17	6	9	1	9	2	6	1	8	3
June	452	31	105	15	10	4	12	3	12	0	31	4	16	2
July	286	31	82	16	20	5	38	3	19	1	25	6	19	1
August	275	34	91	11	27	5	46	3	46	4	37	6	30	6
September	123	17	72	7	34	4	31	1	34	6	36	5	22	2
October	87	14	40	10	30	6	23	4	28	2	29	3	23	3
November	115	11	28	8	18	5	10	5	14	1	22	6	18	0
December	168	15	23	7	15	5	12	4	13	0	8	2	7	2
Total	1,922	239	1,252	157	235	64	218	46	202	21	238	43	187	28

Deducting the two cases that were reported under mistaken diagnoses only five cases occurred among Ethiopians and yet we have no reason to believe that colored people are immune.

PREVALENCE BY MONTHS.

Months.	Cases.	Deaths.
January	14	1
February	6	2
March	18	1
April	6	5
May	8	3
June	16	2
July	19	1
August	30	6
September	22	2
October	23	3
November	18	0
December	7	2
Total	187	28

GEOGRAPHIC DISTRIBUTION BY WARDS.

Ward.	*Cases.*	*Deaths.*	*Ward.*	*Cases.*	*Deaths.*
1	15	1	16	4	1
2	8	0	17	4	1
3	8	0	18	13	3
4	5	1	19	12	3
5	3	0	20	13	0
6	7	0	21	1	0
7	10	1	22	3	1
8	8	2	23	9	3
9	6	1	24	5	3
10	1	0	25	5	0
11	3	2	26	2	0
12	3	0	Public Institutions	24	3*
13	6	0		—	—
14	5	0			
15	4	1	Total	187	28

Mortality rate 14.6

Death-rate per 100,000 based upon the United Census Bureau Population, 387,543, July 1, 1912 ..... 7.23

Not including these two cases the average death-rate per 100,000 was 6.7

*Two imported cases treated in the hospitals died.

It is interesting to note that those wards which are not adequately sewered contributed the greatest number of cases, viz., the 1st, 19th and 20th. The 19th ward in particular occupies an unenviable position, being just below the 20th ward, reaping the benefits of the hillside drainage.

The completion of Cincinnati's new sewer system will witness a very material decrease in the number of cases and deaths from typhoid fever.

IMPORTED CASES.

	Cases.	*Deaths.*
Imported cases who came from neighboring cities to our hospitals for treatment	17	2
	9.1%	7.1%

TEMPORARY ABSENCE.

Patients who were temporarily absent from Cincinnati within 30 days prior to their illness*	49	8
	26.2%	28.6%
Total	66	10
	35.3%	35.7%

Imported Cases:

Ludlow and Newport	3
Bethel	2
Addyston	2
Reading	2
Other neighboring cities	8
Total	17

This classification does not include those individuals who were away from the city just for a day or two.

WATER SUPPLY.

	Cases.	*Deaths.*
Direct from river	8	1
	4.3%	3.6%
Wells and cisterns	15	3
	8. %	10.7%
Springs	7	1
	3.7%	3.6%
Total number drinking from irregular water supplies	30	5
	16. %	17.9%

Our experience shows that about two thirds of the samples taken from cisterns, wells and springs and submitted for bacteriologic examination

were polluted, or to be accurate, of the 222 samples taken only 34.7 per cent. were free from contamination.

In addition to drinking water from cisterns and wells the presence of outdoor privy vaults was noted five times.

In two instances the outdoor privy vault was present as an etiologic factor where spring was used as a beverage. Three samples taken from three different springs, which were suspected as the source of infection, were found contaminated.

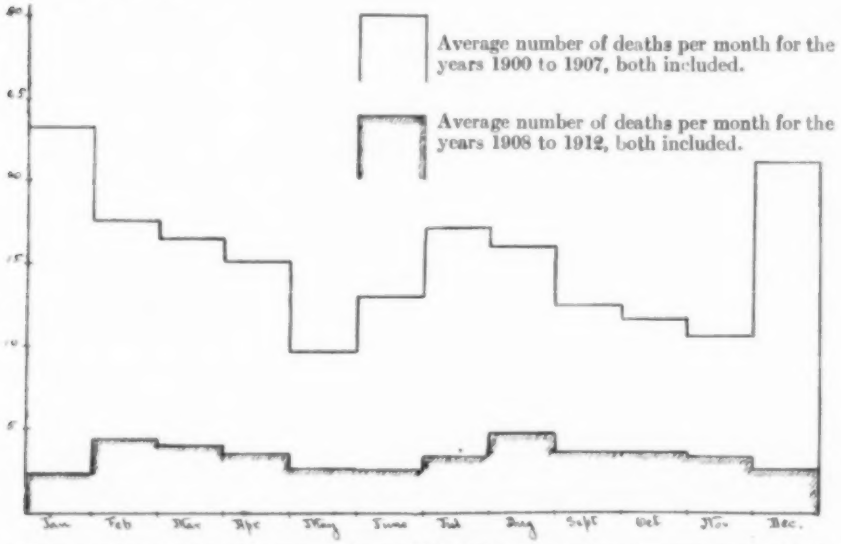


Chart showing the high winter prevalence of Typhoid Fever before the completion of the Water Works and Filtration Plant, October 1907, and subsequent reduction.

Milk Supply.

During the year 1912 no cases of typhoid fever occurred in Cincinnati which were traceable to milk-borne infection.

Personal Contact.

	Cases.	*Deaths.*
Associated 30 days prior to illness with patients in febrile stage	11	1
	5.9%	3.5%

Other Factors.

Cistern water Overflowing vault	6
Overflowing vaults	3
Contact only	2
	11

Most of our contact cases occurred among the attendants of patients and members of families in which a case of typhoid fever was treated. In some of our so-called contact cases the period of incubation between the first and second case was relatively short and in some cases not determined. The original source of infection may have been common for both cases.

Disposal of Sewage.

Cases reported from residences which were not connected with sewer:

		Cases.	*Deaths.*
Open privy vaults	19	21	4
Open gulley	2		
	21	11.2%	14.3%

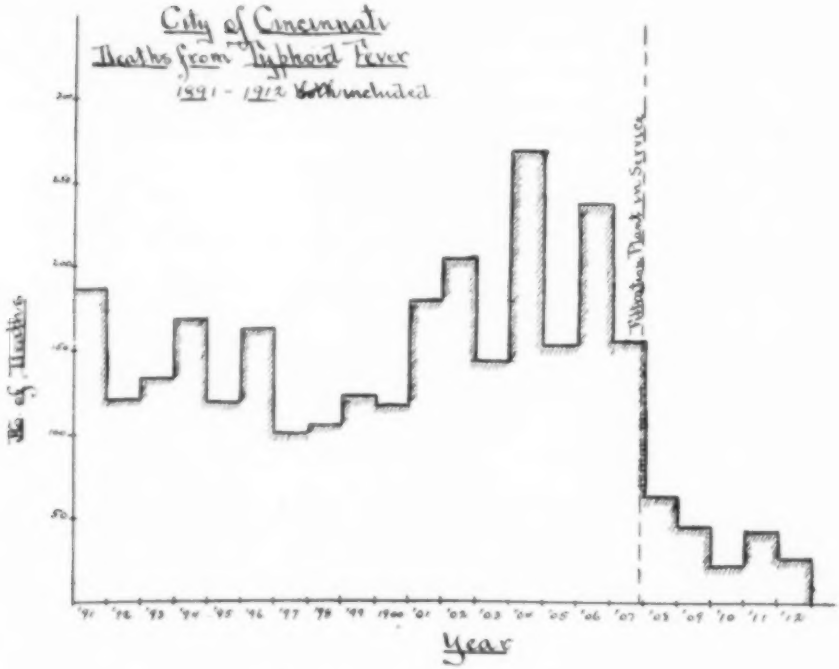
The waste waters from these premises were carried away in some instances; in other instances they were discharged through open drains or flushed through pipes into gulleys, vaults and cesspools or out onto the street.

The following table shows the disposal of body discharges from cases included in the various groups:

	Open Privy.	Open Lot.	River.	Flush Toilet.	Total.
Temporary absence	14	1	0	34	49
Irregular water supply	13	1	3	13	30
Personal contact	9	0	0	2	11
Premises not sewered	19	2	0	0	21
Total	55	4	3	49	111

A glance at this table shows the importance of installing flush toilets which are sewer connected. Among those who were temporarily absent from the city within thirty days prior to their illness, the presence of the outdoor privy vault was noted only fourteen times (or 70 per cent. lived in houses which were properly sewered), while in the other groups it was a rather constant factor.

The table undoubtedly casts a suspicion upon the open privy as the sponsor of polluted cisterns and wells. Outdoor privy vaults were noted in connection with cisterns and wells eleven times out of fifteen, or in 73 per cent. of the cases, a proportion which coincides fairly well with the number of samples found contaminated by bacteriologic examination.



MISTAKES IN DIAGNOSIS.

Of the 187 cases reported we feel quite certain that twelve were reported under mistaken diagnosis. The correct diagnosis which was ascertained upon investigation is given for each case as follows:

	Cases.	*Deaths.*
Obstruction of bowel	1	
Influenza	1	
Appendicitis	1	
Pneumonia	2	
Tuberculosis	1	
Minor gastro intestinal disorders	3	
Septico pyæmia and alveolar abscess	1	
Doubtful	2	
	12	
	6.4%	

The two doubtful cases were gastro intestinal disorders of more or less severity but not presenting the appearance nor running the clinical course of typhoid. The agglutination reaction with B. paratyphosus was positive.

DEATHS FROM TYPHOID IN THE FIFTY LARGEST CITIES OF THE UNITED STATES DURING THE YEAR 1912.

Location.	Population.	Deaths from Typhoid.	Av. Deaths per 100,000.	Rank.
New York, N. Y.	5,064,237	500	9.87	15
Chicago, Ill.	2,294,711	173	7.54	9
Philadelphia, Pa.	1,606,102	223	13.88	25
St. Louis, Mo.	712,027	74	10.39	18
Boston, Mass.	711,128	57	8.01	10
Cleveland, Ohio.	596,970	37	6.19	3
Baltimore, Md.	569,560	136	23.88	39
Pittsburgh, Pa.	550,667	70	12.71	21
Detroit, Mich.	503,445	93	18.47	36
Buffalo, N. Y.	439,666	37	8.42	11
San Francisco, Cal.	433,488	61	14.07	27
Milwaukee, Wis.	400,279	99	24.73	41
Cincinnati, Ohio.	387,543	28	7.23	6‡
Los Angeles, Cal.	386,014	53	13.73	24
Newark, N. J.	369,317	26	7.04	4
New Orleans, La.	350,695	49	13.98	26
Washington, D. C.	342,776	78	22.75	38
Minneapolis, Minn.	323,476	37	11.44	19
Jersey City, N. J.	281,497	21	7.46	8
Seattle, Wash.	277,420	20	7.21	5
Kansas City, Mo.	265,977	34	12.78	22
Indianapolis, Ind.	246,928	45	18.22	34
Providence, R. I.	235,222	24	10.20	17
Portland, Ore.	234,546	39	16.63	29
Rochester, N. Y.	230,412	27	11.72	20
Denver, Colo.	230,249	...	.....	..
Louisville, Ky.	229,323	47	20.49	36
St. Paul, Minn.	226,300	23	10.16	16
Columbus, Ohio.	193,822	39	20.12	37
Toledo, Ohio.	176,698	58	32.82	43
Oakland, Cal.	167,401	16	9.56	14
Atlanta, Ga.	167,040	59	35.32	45
Worcester, Mass.	152,150	...	.....	..
Birmingham, Ala.	150,249	56	37.27	46
Syracuse, N. Y.	143,602	24	16.71	30
New Haven, Conn.	139,325	34	24.40	40
Memphis, Tenn.	137,467	77	56.01	47*
Scranton, Pa.	135,894	12	8.83	12
Richmond, Va.	131,453	22	16.74	31†
Paterson, N. J.	130,167	6	4.60	2
Omaha, Neb.	128,912	17	13.19	23
Fall River, Mass.	122,52	22	17.96	33

DEATHS FROM TYPHOID IN THE FIFTY LARGEST CITIES OF THE UNITED STATES DURING THE YEAR 1912.—*Continued.*

Location.	Population.	Deaths from Typhoid.	Av. Deaths per 100,000.	Rank.
Spokane, Wash	120,994	20	16.53	28
Dayton, Ohio	120,364	22	18.27	35
Grand Rapids, Mich	118,163	40	33.85	44
Nashville, Tenn	112,744	36	31.93	42
Bridgeport, Conn	108,999	8	7.34	7
Lowell, Mass	108,759	10	9.19	13
Cambridge, Mass	107,734	3	2.78	1
Albany, N. Y	101,724	18	17.6	32

*Exceptional, owing to overflow of river.
†Six cases contracted outside of Richmond.
‡Two cases imported; died in Cincinnati hospitals.

while with B. typhosus clumping was slow, many bacilli remaining sluggishly motile.

SOURCE OF INFECTION NOT ESTABLISHED.

Individuals who drank tap water and who were not absent from the city nor associated with patients in the febrile stage within thirty days prior to their illness and who lived in houses which were sewer connected:

Cases.	*Deaths.*
47	8
25.2%	28.5%

After prolonged and careful studies a fairly large number of cases have been left unaccounted for and are included in the above group. However, the experience of other investigators teaches us that other factors which have not been mentioned play an important rôle in the etiology of typhoid fever.

Many patients in this group gave a history of eating raw vegetables and fruits. Not unfrequently the farmer uses as a fertilizer night soil which has not been properly sterilized. Lettuce, celery, radishes, strawberries might be easily infected in this manner or by an infectious individual over whom we have no control.

Previous researches have demonstrated conclusively that the fly must assume an important rôle as a disseminator of typhoid fever. We may assume that the infection may be spread by insects, cats and other animals. The information which we got as to screening was very unsatisfactory except in those cases in which the premises were not screened at all.

A history of eating raw oysters and shell-fish obtained was in a small percentage of these cases. This information was also obtained in some cases included in other groups but not considered as a primary factor because a more important one prevailed.

In some instances parents were inclined to cast suspicion upon ice cream purchased from street vendors.

With our present knowledge "bacillus carriers" constitute a very important factor in the spread of typhoid fever. When we consider the large number of cases which came down years ago before the completion of the new water works it is difficult to understand why typhoid is not more prevalent in Cincinnati. Maybe the organisms have become attenuated or avirulent.

SUMMARY.

	Cases.	Per Cent.	Deaths.	Per Cent.
Imported cases and temporary absence	66	35.3	10	35.7
Irregular water supplies	30	16.0	5	18.
Personal contact	11	5.9	1	3.5
Premises not sewered	21	11.2	4	14.3
Mistaken diagnosis	12	6.4		
Source of infection not established	47	25.2	8	28.5
Total	187	100	28	100

RELATION OF PURITY OF WATER SUPPLY TO TYPHOID FEVER.

J. W. Ellms,

Superintendent Filtration Plant, Cincinnati, Ohio.

A polluted water supply has always been recognized as a carrier of disease. This fact has been so repeatedly demonstrated in the case of typhoid fever that it would seem almost unnecessary to call attention to it again. But Cincinnati has made such a remarkable record in reducing typhoid fever by changing from an impure to a purified water supply that the truth of the adage that "an ounce of prevention is worth a pound of cure," has more force than ever before.

For the three years preceding the introduction of a purified water supply, Cincinnati's typhoid death-rate averaged 53 per hundred thousand of population. For the five years following the purification of the water supply, the death-rates per hundred thousand were 19, 13, 5.7, 11.4, and 7.1, respectively. This represents an average reduction in the number of deaths from this disease of nearly 80 per cent. The reduction in the cases reported is very nearly 85 per cent. when estimated for this same period. Whether other sanitary reforms approximately coincident with the purification of the water supply have not played some part in the diminution of cases from this disease, the writer is not prepared to say; but there is little doubt that the principal agency has been the substitution of a pure for an impure drinking water.

The variation in the typhoid death-rate since the water supply has been purified is of interest, especially as the general downward tendency in the number of deaths from the time purification was begun in 1908, reached its minimum in 1910, only to be doubled in the year 1911, and to fall again in 1912. The question naturally arises as to whether these fluctuations are in any way related to variations in the hygienic quality of the now purified water, or to sources of infection entirely unrelated to the water supply.

The following table includes for the four years, 1909 to 1912, both inclusive, summaries of certain bacterial data obtained in the examination of the unpurified Ohio River water, and the purified water supplied to the city. The fluctuations in the typhoid fever death-rate are also noted for purposes of comparison. Calcium hypochlorite was not applied to the filtered water as a disinfecting agent in either 1909 or 1910, but was used for the first three months of 1911, and for the first six and one-half months of 1912.

A careful study of this table with a view to establishing some relation between the fluctuations in the typhoid death-rate and the quality of the water does not lead to any very positive conclusions. It immediately raises a question as to whether we really obtain any direct measure of the purity of a water in the usual bacterial examinations which are made. So far as the total number of organisms removed is concerned these results

COMPARISON OF THE TYPHOID FEVER DEATH-RATE WITH THE HYGIENIC QUALITY OF THE WATER SUPPLY OF CINCINNATI.

For the year	1909.	1910.	1911.	1912.
Typhoid fever death-rate per 100,000 of population	13	5.7	11.4	7.1
Percentage reduction from average death-rate for three years preceding introduction of filtered water supply	75	90	79	89
Average number of bacteria per c.c.:				
In river water	9300	8900	13790	11130
In filtered water	75	75	39	26
Percentage reduction of bacteria by purification	99.2	99.2	99.7	99.8
Yearly percentages of presumptive positive B. Coli results obtained in various amounts of the river and filtered water:				
In river water in 1 c.c.	93.2	91.0	85.3	93.5
In filtered water in 1 c.c.	1.0*	7.9*	5.2†	3.0‡
In filtered water in 100 c.c.	66.0*	65.0*	84.3†	51.6‡
Percentages of presumptive positive. B. Coli results in 100 c.c. of filtered water for the period of disinfection:				
Before disinfecting filtered water	—	—	88.9	89.3
After disinfecting filtered water	—	—	12.8	27.7

* No sterilizing agent used.
† Disinfection with calcium hypochlorite for first three months of 1911.
‡ Disinfection with calcium hypochlorite for first six and one-half months of 1912.

indicate a water of high purity. On the other hand the presence of fecal or gas producing organisms likely to be associated with the typhoid bacillus, as shown by the presumptive positive B. coli figures, would lead one to believe that the entire absence of these organisms in a water is by no means absolutely necessary as an indication of what experience has shown to be a safe drinking water. The reduction in the number of B. coli effected by filtration alone is evidently in the same proportion as that obtained in the reduction of the total number of bacteria. No selective action takes place in filtration, although there appears to be some such action when the disinfecting agent, calcium hypochlorite, is used.

So long as bacteriology is unable to furnish reliable and rapid methods for the isolation of pathogenic organisms in water, it will be necessary to rely on circumstantial evidence, such as has been furnished by the remarkable reduction of typhoid fever in Cincinnati, following the introduction of a purified drinking water. Since all those cases, in which the source of the infection remains untraced, may have been infected through agencies such as flies, shell-fish, raw vegetables, fruits and bacillus carriers, it reduces the probability of our present purified drinking water being a source of infection to practically zero.

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WILLIAM CRAWFORD GORGAS.

Mosquitoes and malaria: oil tanks and drainage ditches; dispensaries, hospitals, and sanitary squads; these we have come to associate instinctively with the sanitation of the Canal Zone. But all of these are mere symbols—symbols of the all-pervading influence of Manson, of Ross, of Finlay, of Carter, and Lazear, and Carroll, and Reed, who made the Canal a possibility, and of him who has organized and executed the work foreshadowed by their coming—William Crawford Gorgas.

They say blood will tell, and it did tell in the case of Gorgas. His grandfather was one time governor of the state of Alabama, and his father was one of those brave idealists who, graduated by the West Point Military Academy, without a murmur sacrificed his commission in the army when conscience told him that his first duty was to the state that had nurtured him—and to the Confederacy. Gorgas himself is a child of the South, of a period when "yellow fever" was still a term to strike terror to the hearts of all. To the University of the South he owes his academic education, and the Bellevue Hospital Medical College claims the distinction of having

graduated him as a doctor of medicine. He walked the wards of old Bellevue; and then came the army—and Florida, Dakota, Texas, and wherever else a soldier's life might lead; but always as he moved from place to place a host of grateful patients and loving friends were left behind. For Gorgas is above all things else a friendly man. No finer evidence of this capacity for friendship can be found than in the love and esteem in which he is held by the people of Havana, acquired in some inconceivable way even while he was engaged in the very duty of enforcing with military precision and firmness the sometimes harsh requirements of the sanitary code.

But if a capacity for friendship is one of his characteristics, modesty is another not less marked. The unassuming dignity with which he entered upon the task of making the Canal Zone habitable is a lesson for all. Here again his wonderful patience and tact, and his good judgment and knowledge of men, served him and his country in good stead. For, arriving at the Zone in the very first vessel that carried the officers who were to build the Canal, he has kept placidly on his way in the discharge of his duty, unruffled by the rumblings and misunderstandings about him, until he is today the only one of the chief officials first assigned to the task, who has remained to finish the whole duty assigned to him.

Duty well done—a supreme ever-animating ideal in a soldier's heart, and brain, and body. Uncomplaining and loyal acceptance of the allotted task. Unceasing and untiring effort toward the accomplishment of the end sought. These, in William Crawford Gorgas, have made the Panama Canal possible—for these are the things that have made it possible for every one, even for the chief engineer and down to the humblest laborer in the trenches, to live in health and safety on the Isthmus. No wonder, then, that South Africa should appeal for Gorgas' help.

THE JOURNAL IN 1913.

The year 1913 has witnessed a gratifying increase in the number of subscribers to the JOURNAL, indicating that the JOURNAL is serving a useful purpose. The volume concluded with this issue shows an increase of 38 per cent. in the number of pages as compared with 1912. There has been an increase in practically all departments, particularly in those sections devoted to notes and reviews. Further improvements are planned for the future.

It is evident that there are many persons who do not now see the JOURNAL who would derive an actual benefit from it. The subscribers are in a position to perform a signal service by each getting one new subscriber. The doubling of our circulation would go a long way towards making the JOURNAL self supporting. Do you believe sufficiently in the JOURNAL to aid in this practical manner?

Your help in this important matter is earnestly solicited.

A STUDY OF THE HYGIENIC CONDITION OF THE AIR IN CERTAIN TEXTILE MILLS WITH REFERENCE TO THE INFLUENCE OF ARTIFICIAL HUMIDIFICATION.

H. W. Clark and Stephen DeM. Gage.

Read before the Sanitary Engineering Section, American Public Health Association, Washington, D. C., 1912.

(Concluded from November.)

Condition of the Air in Spinning and Weaving Departments of Certain Cotton and Woolen Mills.

As has already been stated, the principal object of the investigation was to obtain data upon the condition of the air in weaving and spinning rooms, since these were the rooms to which the Massachusetts law particularly applied. The processes of spinning the cotton or wool fibers into yarn and weaving that yarn into cloth are generally understood, and description of them here is unnecessary. In both processes a more or less careful control of the atmospheric conditions is considered necessary in order to obtain the best results, especially in the manufacture of the finer grades of goods, and many of the rooms which were examined were equipped with apparatus for increasing or controlling the humidity.

Spinning Rooms: Twelve spinning rooms in three different cotton mills and two different woolen mills were investigated. In the cotton mills only ring spinning was found, four of the rooms examined being equipped with humidifiers, while four others had no humidifiers in operation. Although artificial humidification is supposed to increase the moisture content of the air and to lower the temperature to some extent, the humidity was not appreciably greater in the rooms which were equipped with humidifiers, while those containing no humidifiers were generally somewhat cooler. In the four rooms containing humidifiers the dry bulb temperature ranged from 76° to 81° F., the wet bulb temperature from 45° to 63° F., and the relative humidity from 29 to 59 per cent. In the four rooms without humidifiers the actual temperature varied from 68° to 79° F., the sensible temperature from 54° to 63° F. and the relative humidity from 27 to 46 per cent. Although the temperature of six of these eight spinning rooms was above 75° F. and of two of them was above 80° F., the sensible or wet bulb temperature was in all cases below 70° F.

In the woolen mills, two English or cap spinning rooms and two French or mule spinning rooms were examined. In the English spinning rooms the

dry bulb temperature ranged from 72° to 86° F., the wet bulb temperature from 57° to 65° F., and the relative humidity from 21 to 42 per cent. Neither of these rooms contained humidifiers. In French spinning a much greater amount of moisture is said to be required in the air than in the English process and both French spinning rooms which were examined were equipped with humidifiers. In these two rooms the actual temperature ranged from 76° to 87° F., the sensible temperature from 73° to 82° F., and the relative humidity from 65 to 92 per cent. While the actual temperature of these French spinning rooms was very little higher than that in many of the other spinning rooms, the sensible temperature was very much higher owing to the increased humidity, and the rooms felt very hot and stuffy. According to the superintendent of one of these rooms, the humidity was not supposed to fall below 65 per cent., while the superintendent of the other mule spinning room stated that the normal humidity which he attempted to maintain was about 72 per cent. and provision was made for blowing steam into the air if the artificial humidifiers failed to produce the required effect. In the former of these rooms the average sensible temperature was 74° F., while in the latter nearly all of the wet bulb thermometer readings were above 75° F. and many readings were above 80° F., or considerably above the "comfort point."

The numbers of room temperature bacteria in the air of the cotton spinning rooms ranged from 600 to 8,200 per cubic meter, and the numbers of bacteria of the body temperature types ranged from less than 200 to about 15,000 per cubic meter. On the exposed plates, the room temperature counts varied from 3 to over 500 and the body temperature counts varied from 4 to 350. The average number of both room temperature and body temperature bacteria were much higher in those rooms which were equipped with humidifiers than in those containing no humidifiers, although the reverse was true in the case of counts on the exposed plates. Fermenting organisms were found in five liters of air in about two thirds of the samples from rooms which contained no humidifiers and in about 30 per cent. of the samples from the rooms in which air moisteners were in operation, while B. coli were found in about 17 per cent. of the samples from the former but were not found in the latter class of rooms.

The bacterial content of the air of the English spinning rooms in the woolen mills was much lower than in similar rooms in the cotton mills, the largest number of bacteria found in any sample from an English spinning room being about 600 per cubic meter, and a considerable proportion of the samples contained less than 200 bacteria per cubic meter. In one of the rooms where wool was being spun on mules also the bacterial content of the air was very low, but in the other French spinning room extremely high numbers of body temperature bacteria were obtained on all samples collected by the sand filter method, although the counts upon the exposed

plates were low in all cases. The probable reason for the high bacterial counts in the mule spinning room in this mill and also in the ring spinning

TABLE II.

AVERAGE RESULTS OF EXAMINATION OF AIR IN SPINNING ROOMS.

Mill.	Room.	Temperature. (Degrees F.)		Relative Humidity.	In One Cubic Meter.				Plates Exposed 15 Minutes.			
					Bacteria.			Moulds.	Bacteria.			Moulds.
		Dry Bulb	Wet Bulb		20°C.	40° C.			20°C.	40° C.		
						Total.	Red.			Total.	Red.	
Cotton Spinning Rooms Containing Humidifiers.												
B.....	1	80	62	30	4,200	1,500	175	300	47	13	1	1
B.....	2	77	64	49	2,200	750	100	500	11	26	0	1
C.....	3	84	60	31	900	12,500	10,700	150	30	31	7	0
D	4	84	64	32	6,900	3,800	2,600	100	430	170	55	3
Average ..	—	81	63	37	3,550	4,600	3,400	260	130	60	16	1
Maximum	—	87	66	59	8,200	15,000	12,400	800	520	250	100	4
Minimum	—	76	45	29	600	*	*	*	3	4	0	0
Cotton Spinning Rooms Without Humidifiers.												
B.....	5	79	60	31	1,800	1,200	100	400	275	10	0	3
C.....	6	76	58	31	2,200	900	150	250	320	110	13	1
C.....	7	70	57	37	1,500	500	350	2,200	16	270	260	1
D.....	8	72	58	42	4,400	2,000	800	400	300	70	32	0
Average ..	—	74	58	35	2,500	1,150	350	810	230	115	76	1
Maximum.	—	79	63	46	4,400	2,000	800	2,800	450	350	340	3
Minimum .	—	68	54	27	1,000	400	*	*	12	10	0	0
Wool (French) Spinning Rooms Containing Humidifiers.												
E.....	9	81	74	74	4,100	31,800	25,300	125	6	5	1	0
F.....	10	84	79	81	575	125	125	175	2	2	0	1
Average ..	—	82	77	78	2,300	16,000	12,700	150	4	4	1	1
Maximum.	—	87	82	92	15,600	36,400	30,400	200	15	7	2	1
Minimum	—	76	73	65	*	*	*	*	0	1	0	0
Wool (English) Spinning Rooms Without Humidifiers.												
E.....	11	72	58	40	100	100	100	150	5	33	8	1
E.....	12	83	61	26	400	150	150	150	23	20	15	2
Average ..	—	78	60	33	250	125	125	150	14	26	11	2
Maximum.	—	86	65	42	600	200	200	200	26	63	30	3
Minimum	—	72	57	21	*	*	*	*	3	1	0	0

Fermenting organisms found in some samples of air from rooms 2, 4, 6, 7 and 8.
No B. coli were found in any of the samples.
All maximum and minimum results based on individual determinations.
* = less than 200.
All humidifiers of spray type. Room 10, Mill F, also equipped with auxiliary steam jets.

rooms in certain of the cotton mills will be discussed in a subsequent chapter. No fermenting organisms were found in the air of any of these wool spinning rooms.

The average results of the examination of the air in these various spinning rooms are shown in Table II.

Weave Rooms: The air conditions in fifteen different weave rooms were investigated, thirteen of the rooms being distributed in four different cotton mills and two being located in a woolen mill. In six of the cotton weave rooms no humidifiers were in operation, five contained humidifiers of the spray type and two were equipped with humidifiers of the cloth filter type. In the rooms containing humidifiers, the dry bulb temperature ranged from 62° to 89° F., the wet bulb temperature from 49° to 73° F., and the relative humidity from 32 to 64 per cent. In six of these rooms the average dry bulb temperature was over 75° F. and in two the average was over 80° F. In only one of these rooms was the average wet bulb or sensible temperature higher than 70° F., although in one other room (No. 14) a wet bulb temperature above 70° F. was found in a few places. Both of these rooms were equipped with humidifiers of the cloth filter type. In the six cotton weave rooms which did not contain humidifiers the air temperature ranged from 57° to 83° F., the wet bulb temperature from 45° to 65° F., and the relative humidity from 31 to 69 per cent. In four of these rooms the dry bulb temperature averaged above 75° F., and in two the average temperature was above 80° F., but in no case were wet bulb temperatures as high as 70° F. found in any of these rooms. There was considerable variation in the temperature and humidity even in the rooms in which artificial humidification was practised, differences of 8 to 10 degrees in temperature and of 20 to 25 per cent. in humidity being frequently observed in different parts of the same room. Both of the two wool weave rooms examined were in the same mill, neither being equipped with humidifiers. The range of both temperature and humidity in these rooms was very slight, the average dry and wet bulb temperatures being 77° and 59° F. respectively, and the average humidity about 31 per cent.

There was a wide difference in the bacterial content of the air of the various cotton weave rooms. In two rooms which were equipped with humidifiers of the cloth type, the number of room temperature bacteria averaged 12,000 and 6,800 per cubic meter and the types of bacteria growing at body temperature averaged 1,500 and 2,400, respectively. In another room in the same mill which contained no humidifiers the room temperature bacteria averaged over 88,000 and the body temperature bacteria nearly 13,000 per cubic meter. The air of the rooms which contained humidifiers of the spray type almost without exception contained many more bacteria of all types, and also more moulds, than in the rooms in the same mills which were not equipped with humidifiers. The numbers of bacteria in the air of four of the five rooms which were equipped with this type of humidifier averaged over 5,000 per cubic meter, while in the same mills two of the rooms where there was no artificial humidification showed room

temperature counts by the sand filter method of only 400 bacteria per cubic meter, and in only one room was a count of over 5,000, per cubic meter

TABLE III.

AVERAGE RESULTS OF EXAMINATION OF AIR IN WEAVING ROOMS.

Mill.	Room.	Temperature. (Degrees F.)		Relative Humidity.	In One Cubic Meter.				Plates Exposed 15 Minutes.			
					Bacteria.			Moulds.	Bacteria.			Moulds.
		Dry Bulb.	Wet Bulb.		20° C.	40° C. Total.	40° C. Red.		20° C.	40° C. Total.	40° C. Red.	
Cotton Weave Rooms Containing Humidifiers.												
A	13	84	71	49	12,000	1,500	700	220	46	17	5	0
A	14	82	67	47	6,800	2,400	870	550	250	61	13	1
B	15	77	64	49	5,450	1,800	525	550	14	10	0	0
B	16	78	66	52	6,550	23,500	18,700	425	250	11	0	0
C	17	76	63	47	2,500	2,500	1,400	1,600	19	61	33	0
C	18	78	63	43	5,100	4,700	1,600	470	29	19	4	0
D	19	66	52	37	9,100	6,700	1,330	870	460	25	10	0
Average	—	77	64	46	6,800	6,200	3,600	670	152	29	9	0
Maximum.	—	89	73	64	12,400	72,000	61,000	2,000	990	210	40	5
Minimum	—	62	49	32	1,400	200	*	*	6	4	0	0
Cotton Weave Rooms Without Humidifiers.												
A	20	76	64	55	88,500	12,800	4,000	950	870	900	44	0
C	21	81	64	38	4,200	1,400	200	100	28	10	2	0
C	22	81	63	36	400	1,000	300	350	8	8	3	1
C	23	76	59	36	2,000	530	200	200	28	10	0	0
D	24	57	45	35	400	800	400	100	150	10	4	0
D	25	65	50	35	9,100	10,100	4,800	200	112	25	4	0
Average	—	72	58	39	17,400	4,400	1,650	317	200	160	9	0
Maximum.	—	83	65	69	188,000	20,400	6,600	3,400	1,450	3,025	77	2
Minimum	—	57	45	31	200	200	*	*	3	3	0	0
Wool Weave Rooms Without Humidifiers.												
E	26	75	57	31	200	800	100	100	12	5	0	0
E	27	79	60	31	200	200	100	400	62	8	2	0
Average	—	77	59	31	200	500	100	250	37	7	1	0

Fermenting organisms found in some samples of air from weave rooms 13, 14, 15, 18, 19, 20 and 25.

B. coli found in some samples of air from rooms 19 and 20.

All maximum and minimum results based on individual determinations.

* = less than 200.

Humidifiers in Mill A (Rooms 13 and 14) of cloth filter type.

Humidifiers in Mills B, C and D (Rooms 15 to 19 incl.) of spray type.

obtained. Fermenting bacteria were found in five liters of air in about 21 per cent. of the samples collected from rooms containing humidifiers and in about 46 per cent. of the samples from rooms without humidifiers, and

B. coli were found in about 7 per cent. of the samples from each of these two classes of rooms.

In the two wool weave rooms the numbers of bacteria in the air were very low, the highest count obtained being only 800 per cubic meter. No fermenting organisms were found in any of the samples from either of these rooms.

The average results of the examination of the air in these various weave rooms are shown in Table III.

Air Conditions in Picker and Carding Rooms.

So far as the amount of dust in the air is concerned, the rooms where the picker and carding processes are in operation probably represent the worst conditions to be found in the textile industry.

Picker Rooms: In the picker room, heavy machinery opens up the masses of cotton or wool fibers, mixes it, and beats it to remove the dirt. The best results are accomplished if the fibers are dry, and the humidity is usually kept as low as possible. Most picker machines are equipped with exhaust fans to draw away the dirt, but a large amount of dust and fly escapes into the air in cotton picker rooms. Wool is usually scoured or washed before being put through the picker, and the air conditions in this department are usually much better in woolen than in cotton mills. In the two cotton picker rooms examined the range in temperature was from 65° to 72° F. and in humidity was from 32 to 42 per cent. In one of these rooms the total number of bacteria near the intake of the picker machine averaged over 23,000, and at the outtake of the machine over 11,000 per cubic meter, and the bacteria growing at body temperature averaged 8,800 and 1,800, respectively. There were large numbers of moulds in the air in this room, and fermenting organisms were found in many of the samples. On plates exposed for fifteen minutes the counts averaged about 600 when incubated at room temperature and about 100 when incubated at body temperature. In the other cotton picker room the total numbers of bacteria obtained from one cubic meter of air averaged about 12,000 at the intake and about 95,000 at the outtake of the machine. The numbers of bacteria developing at body temperature in this room varied from 200 to over 9,000 per cubic meter, and the number of moulds averaged 600 per cubic meter. Plates exposed fifteen minutes in this room showed counts ranging from 500 to over 3,000 after incubation at room temperature and from 15 to over 700 after incubation at body temperature. Although fermenting organisms were isolated from five liters of air in every sample collected in this room, in no case were bacteria of the colon type isolated. It is interesting to note, however, that the proportion of bacteria producing red colonies on litmus-lactose agar plates was extremely low in both of these cotton picker rooms. In the one wool picker room

examined, the temperature averaged about 66° F. and the humidity about 45 per cent. The total number of bacteria in the air of this room averaged about 4,600 per cubic meter, and the average body temperature count was less than 200 per cubic meter. The numbers of colonies developing on exposed plates were also much lower than in the rooms where cotton was being manipulated, the average room temperature count being about 35 and the average body temperature count being about 80. The number of moulds in the air of this room was also very low, and fermenting bacteria were not isolated from any of the samples.

Carding Rooms: In the carding machines the stock which has been freed from coarse dirt and partly opened up by the pickers is further manipulated by toothed rolls until it is entirely free from dirt and lumps and is in a free and open condition with each fiber free and separate. In cotton carding rooms the air is generally filled with dust and fly, but as the wool is free from dirt when it comes to the cards and as oil is added to the stock in the carding process to replace the natural lubricant which was removed by scouring the atmospheric conditions in the wool carding rooms are far less objectionable.

The carding rooms in two cotton mills and one woolen mill were examined. In carding wool, the work is said to run better when the humidity is relatively high, and the wool carding room examined was equipped with humidifiers of the spray type. In this room the temperature ranged between 68° and 75° F., and the relative humidity between 47 and 100 per cent. Although the average sensible temperature in this room was only 63° F., a number of wet bulb readings of 70° F. or over were obtained and the records kept by the superintendent show that there are many days when the sensible temperature does not fall below 70° F. The average bacterial content of the air varied from 200 to 1,600 per cubic meter as shown by room temperature plates, and from 600 to 2,200 as shown by body temperature plates. On plates exposed for fifteen minutes from 30 to 210 colonies developed after incubation at room temperature and from 60 to 170 after incubation at body temperature. Fermenting organisms were not found in any of the samples and the numbers of moulds were relatively low. In the carding of cotton, it is attempted to maintain a relatively low humidity as any excess of moisture tends to make the cotton fibers stick to the rolls. The air in both of the cotton card rooms investigated was full of dust and fly, although less so than that of the picker rooms. In one of these rooms, no artificial humidification was employed, while the other was equipped both with spray moisteners and with steam drums, the latter being in use at the time the examination was made. The physical condition of the air in both of these rooms were practically the same, the temperature ranging between 74° and 82° F. and the humidity between 27 and 33 per cent. In one of these rooms the average bacterial content of

the air was over 12,000 per cubic meter as shown by room temperature counts and over 45,000 as shown by body temperature counts. About two thirds of the bacteria developing on the litmus-lactose agar plates produced red colonies. Organisms fermenting dextrose were not found, however, in any of the samples. The average number of bacteria developing on exposed plates was about 2,200 after incubation at room temperature and about 750 after incubation at body temperature. In the cotton carding room in which there was no artificial humidification the total numbers of

TABLE IV.

AVERAGE RESULTS OF EXAMINATION OF AIR IN PICKER AND CARDING ROOMS.

Mill.	Stock.	Temperature. (Degrees F.)		Relative Humidity.	In One Cubic Meter.				Plates Exposed 15 Minutes.			
					Bacteria.			Moulds.	Bacteria.			Moulds.
		Dry Bulb.	Wet Bulb.		20° C.	40° C. Total.	40° C. Red.		20° C.	40° C. Total.	40° C. Red.	
Picker Rooms.												
C . . .	Cotton	72	57	42	17,200	5,300	100	1,200	595	95	10	5
D . . .	Cotton	67	52	32	54,000	4,700	1,500	600	1,800	370	1	0
E . . .	Wool	66	54	45	4,600	200	100	100	35	80	40	0
Carding Rooms.												
C . . .	Cotton	81	60	27	12,800	45,400	31,800	100	2,200	760	0	0
D . . .	Cotton	76	58	30	230,000	18,000	100	300	(Too many to count.)			
F . . .	Wool	74	63	77	1,000	1,000	600	500	100	95	20	2

Fermenting organisms found in some samples of air from the picker rooms in both cotton mills and the carding room in cotton Mill D.

No B. coli found in any of the samples.

Spray humidifiers in carding room in Mill F and steam drums in carding room in Mill D. No humidifiers in other rooms.

bacteria averaged over 200,000 per cubic meter, and the numbers developing at body temperature averaged about 18,000. On plates exposed for fifteen minutes in this room large numbers of bacteria developed after incubation at both temperatures, the numbers being so great in the majority of cases that they could not be estimated with any degree of accuracy. Moulds were present in the air of this room in considerable numbers, and fermenting organisms were found in the majority of five-liter samples examined.

The average results of the examination of the air in these various picker and carding rooms are shown in Table IV.

AIR CONDITIONS IN CERTAIN OTHER WOOL MANUFACTURING PROCESSES.

In addition to the investigation of conditions in the various textile processes previously discussed, examinations were also made in rooms in which fourteen other processes were in operation. Certain of these processes are common to both cotton and wool working, while certain others are commonly employed only in woolen or worsted manufacture. At the time the investigation was made business in the textile industry was at a low stage and most of the rooms which were being operated to their full capacity were relatively small, and in many cases were not equipped with humidifiers, although artificial humidification is often employed in certain of these processes elsewhere. For these reasons, the number of determinations which were made in most of these rooms were sufficient only to give a fairly representative idea of the air condition surrounding the various processes. The average results of examinations of the air in rooms where these various processes were in operation are shown in Table V.

Wool Sorting: In the sorting room the bales of wool are opened, sorted into different grades, and those grades mixed in the proper proportions for the kind of cloth into which it is to be made. The wool as received contains the natural wool grease and a large amount of dirt and foreign matter. It is necessary to maintain a high temperature in the sorting room to soften the grease in order that the fleece may be readily pulled apart, and, as much dirt sifts out in the sorting process, the air is usually very dusty. The room examined was not equipped with humidifiers, and the humidity of the air was relatively low, the dry bulb temperature being about 80° F., the wet bulb temperature being about 62° F., and the relative humidity about 35 per cent. The bacterial content of the air in this room was considerably higher than in any of the other rooms in either of the woolen mills although not as high as in certain departments in the cotton mills. The total number of bacteria averaged over 11,000 per cubic meter, and the body temperature bacteria averaged about 1,000 per cubic meter. The number of moulds found in the air was also high, averaging 2,400 per cubic meter. On plates exposed for fifteen minutes about 280 colonies developed after incubation at room temperature and about 50 after incubation at body temperature.

Combing: In the manufacture of worsteds the carded stock is passed through machines which comb it to remove the short fibers or noils and to lay the longer fibers smooth and nearly parallel. Three combing rooms in two different mills were examined. In one of these which was equipped with humidifiers of the spray type the dry bulb temperature ranged from 65° to 77° F., the wet bulb temperature from 56° to 66° F. and the relative humidity from 49 to 57 per cent. No bacterial examinations were made in this room. In the other two combing rooms, neither of which contained

humidifiers, the dry bulb temperature varied from 75° to 79° F., the wet bulb temperature from from 57° to 59° F., and the relative humidity from 25 to 29 per cent. The average bacterial content of the air as determined by the sand filter method was about 100 per cubic meter in one of these rooms and about 1,400 per cubic meter in the other. The numbers of bacteria developing on exposed plates were similar in both rooms, the average being 17 and 6 respectively.

TABLE V.

AVERAGE RESULTS OF EXAMINATIONS OF AIR IN ROOMS WHERE VARIOUS OTHER WORSTED MANUFACTURING PROCESSES WERE IN OPERATION.

Process.	Temperature. (Degrees F.)		Relative Humidity.	In One Cubic Meter.				Plates Exposed 15 Minutes.			
				Bacteria.			Moulds.	Bacteria.			Moulds.
	Dry Bulb.	Wet Bulb.		20° C.	40° C.			20° C.	40° C.		
					Total.	Red.			Total.	Red.	
Wool sorting	80	62	35	11,200	1,000	200	2,400	280	50	0	2
Combing	78	58	27	750	150	100	100	12	7	2	0
English drawing	77	64	60	1,300	1,000	500	250	3	11	8	0
French drawing	76	67	63	100	400	150	100	5	9	2	0
Twisting	69	56	43	400	100	100	100	4	2	1	2
Beaming and winding	77	60	36	600	200	100	200	20	14	12	1
Dressing	79	62	36	100	250	100	250	20	40	22	1
Slashing	80	62	35	200	600	400	200	28	65	42	3
Inspecting	79	62	37	800	100	100	100	22	4	1	1
Singeing	74	65	62	200	100	100	100	75	2	0	8
Wet finishing	68	62	71	100	8,400	6,600	100	2	2	0	0
Extracting	69	64	76	200	200	100	400	225	28	9	8
Dry finishing	75	64	54	100	800	400	2,200	67	12	3	0

No fermenting organisms found in the air from any of these rooms.

Combing and English and French drawing rooms examined in both Mill E and Mill F. Other processes examined only in Mill E.

Humidifiers in one combing room and in all drawing rooms. No humidifiers in any of the other rooms.

Drawing: From the combs the stock goes to the drawing machines where a number of strands of fiber are slightly twisted together and drawn out preparatory to spinning. In the manufacture of certain kinds of cloth both the combing and drawing are omitted and the sliver from the cards goes directly to the spinning machines. Two different methods are used for drawing wool, known respectively as the English and French systems. Four English and two French drawing rooms in two different mills were investigated, physical examinations only being made in one room of each kind and complete examinations being made in the other four rooms.

Considerable moisture and a fairly high temperature are considered essential in drawing wool by either of these processes, both French and one English drawing room being equipped with humidifiers of the spray type and steam being used to increase the humidity in the other three English drawing rooms.

In the English drawing rooms the dry bulb temperature ranged from 68° to 79° F., the wet bulb temperature from 58° to 78° F. and the relative humidity from 29 to 78 per cent. In one of the rooms in which steam was used the sensible temperature was above 70° F. in places while in another room the sensible temperature averaged 78° F., or considerably above the "comfort point." Bacterial examinations were made only in the three rooms in which steam was used to increase the humidity. The total bacteria in these rooms ranged from less than 200 to over 6,000 per cubic meter, the body temperature bacteria from less than 200 to over 3,000, and the number of moulds in the air from 200 to 600 per cubic meter. The bacterial counts on plates exposed fifteen minutes in all of these rooms were low but in a number of cases the body temperature counts were somewhat higher than the room temperature counts.

In the two French drawing rooms the variation in both actual and sensible temperatures was relatively small, the dry bulb temperatures ranging from 72° to 77° F., the wet bulb temperatures from 66° to 68° F., and the relative humidity from 59 to 78 per cent. The bacterial content of the air in both of these rooms was very low, the largest number of bacteria found in any of the samples being about 400 per cubic meter.

Twisting: After spinning, the yarn for certain kinds of cloth is further twisted to produce a hard finish, or two or more strands of different yarns are twisted together. The average dry and wet bulb temperatures in the twisting room examined were 69° and 56° F., respectively, the average humidity was about 43 per cent., and the average bacterial content of the air was about 400 per cubic meter.

Beaming and Winding: The yarn during spinning is usually wound upon spools, which are then transferred to another machine where the contents of a large number of spools are rewound upon one large spool or section beam. In the room examined the dry bulb temperature was about 77° F., and the wet bulb temperature about 60° F., and the relative humidity about 36 per cent. The average number of bacteria in the air of this room was about 600 per cubic meter.

Dressing and Slashing: In the dressing room the yarn from the section beams is usually run through tubs of sizing or dressing, then through squeeze rolls to remove the excess of size, after which it passes to the slasher where it is dried by being passed over heated rolls. These two processes are frequently combined in one room, but in the mill investigated were performed in separate rooms. The temperature and humidity conditions

in both of these rooms were practically the same, the dry bulb temperature being about 80° F., the wet bulb temperature about 62° F., and the relative humidity about 36 per cent. Dressing being a wet process, the room was free from dust and the bacterial content was very low, less than 200 bacteria per cubic meter being collected by the sand filters. In the slasher room there was some dust, but as most of this originated from the heated yarn and dried particles of size, the bacterial content of the air was also low, averaging less than 600 per cubic meter.

Inspecting: During the processes subsequent to weaving, the cloth is usually carefully examined by perchers or inspectors three separate times: first, after it comes from the looms to check imperfections in weaving, second, after the knots and ends have been trimmed off and the imperfections have been mended, and third, after finishing. The inspecting rooms are generally clean and the air free from dust. In the inspecting room examined the average dry bulb temperature was about 79° F., the wet bulb temperature was about 62° F., and the relative humidity was about 37 per cent. The total number of bacteria in the air of this room was about 800 per cubic meter.

Singeing: Before dyeing and finishing, the cloth is drawn over red-hot rolls, or is passed through a gas flame, to remove the projecting fibers or nap and clean the fabric. In the room examined the singeing was being done with a gas flame, and the air was full of dust and smoke. The average temperature of this room was about 74° F., the wet bulb temperature was about 65° F., and the average humidity was about 62 per cent. The bacterial content of the air in this room was very low, the average number of bacteria being about 200 per cubic meter.

Wet Finishing: After being singed the cloth is passed through hot water and rolled on perforated cylinders and allowed to stand for some hours until cool to set the fibers and prevent excessive shrinkage in the following operations, and is then scoured to remove dirt and grease. Before dyeing, certain kinds of cloth are also submitted to a process called "fulling" or "milling" in which the moisture, heat and friction during the passage of the soaped cloth between rapidly-revolving rolls under high pressure shrinks it to the required extent, and softens the fiber thereby removing the harsh feel. In the wet finishing room examined the dry bulb temperature was about 68° F., the wet bulb temperature was about 62° F., and the relative humidity was about 71 per cent. The number of room temperature bacteria in the air was very low, but over 8,000 bacteria of the body temperature types were found per cubic meter.

Extracting: After "wet finishing" the cloth is dyed and washed, and is then put through centrifugal machines to extract the water before being "dry finished." In the extracting room examined the average dry bulb temperature was about 69° F., the wet bulb temperature was about 64° F.,

and the relative humidity was about 76 per cent. By the sand filter method only about 200 bacteria per cubic meter were found in the air of this room, but on plates which had been exposed for fifteen minutes about 225 colonies developed at room temperature and about 30 at body temperature.

Dry Finishing: After being extracted and dried by being run over steam coils, the cloth passes to the dry finishing room where it is first run through shearing machines to remove or even up the projecting fibers and is then pressed. More or less fly results from the shearing process which is usually removed by suction fans. The air of the dry finishing room examined was comparatively free from dust and fly. The average temperature of this room was about 75° F., the wet bulb temperature was about 64° F., and the relative humidity was about 54 per cent. The bacterial content of the air was comparatively low, but over 2,000 moulds per cubic meter were found by the sand filter method.

Effect of Humidifiers on Numbers of Bacteria and Moulds in the Air.

In the cloth filter type of humidifier such as was studied in Mill A, a greater or less number of bacteria should be removed from the air during its passage through the wet cloths. The bacteria contained in the water which is evaporated into the air, however, should all be left behind on the cloths or in the unevaporated water. The humidifiers in this mill were operated entirely with city water, the small amount of unevaporated water being wasted.

The results of analyses of the air before and after passing through these humidifiers show a reduction of about 58 per cent. in total bacteria, about 30 per cent. in the body temperature bacteria and about 89 per cent. in moulds. The air from similar rooms in this mill which were not equipped with humidifiers contained about seven times as many room temperature bacteria, nearly nine times as many body temperature bacteria and about four times as many moulds, as the air of the rooms which were equipped with humidifiers. The unevaporated water coming away from these humidifiers contained about fifteen times as many bacteria as the water entering them. An examination of the cloths from one of these humidifiers showed that it was covered with a thick felted layer of cotton fibers, etc., which had been removed from the air.

With the various patterns of spray type of humidifiers such as were studied in the other five mills, the water is projected directly into the air before being evaporated with the result that any impurities in the water are added to those in the air. The action of the spray induces a certain flow of air through the apparatus which is washed by the unevaporated water, but the amount of air drawn in and purified in this manner is much

smaller than in the case of the cloth filter type of apparatus. In considering the effect of these humidifiers, therefore, it is necessary to take into account two opposing factors, the addition of germs to the air of the room by the evaporation of the spray, and the removal of germs from the air drawn through the apparatus by the unevaporated water. In four of the five mills which contained humidifiers of this type, the average bacterial content of samples of air collected beneath those humidifiers was considerably greater than that of samples collected at points intermediate between them. In the case of Mill E the air under the humidifiers contained about forty times as many bacteria as that at a distance. The average difference in the numbers of body temperature bacteria, however, was relatively slight except in the case of Mill B, in which the counts on samples from under the spray averaged nearly three times as high as those on samples collected some distance away. In all of these mills the average bacterial content of the air of rooms which contained spray apparatus was considerably higher than that of rooms which were not so equipped. In the case of Mill E, the rooms in which the air had been artificially humidified contained over twenty times as many room temperature bacteria and over one hundred times as many body temperature bacteria as those in which the air had not been treated.

The results of analyses of the water before and after passing through these humidifiers show that in general no considerable numbers of bacteria were removed from the air of the various rooms in which they were installed. In Mills B, E and F there was an increase in the room temperature bacteria in the water amounting to 45, 19 and 10 per cent., respectively, while in Mills C and D there was a decrease of 61 and 38 per cent., respectively. Only in Mill E was any increase noted in the body temperature counts on the unevaporated water, however, while in Mill F a reduction of 58 per cent. in these counts was noted.

The amount of water supplied to the various types of spray humidifiers and the proportion of that water evaporated could not readily be determined, and the statements of the officials in the different mills in this particular were usually rather indefinite and contradictory, so that it is not possible to compute the number of bacteria introduced into the air by any of these humidifiers with any degree of accuracy. The following figures, however, will serve as an illustration of the possible effect of one of these humidifiers: In Mill A it was stated that 85 gallons of water were supplied to each humidifier and that 3 gallons of this water were evaporated. In the weave rooms in this mill the humidifiers were spaced 40 feet apart and the room was about 12 feet high, each humidifier, therefore, supplying moisture to approximately 550 cubic meters of air. The water entering the humidifier contained about 38,000 bacteria per cubic centimeter. Assuming these figures to be correct, about 429 million bacteria were intro-

duced each day into the room by this humidifier or about 780,000 bacteria for each cubic meter of air served. In this particular mill there was a considerable increase in the numbers of bacteria in the water during its passage through the humidifiers and the same method of computation would show that more than seven times as many bacteria were removed as were introduced into the air. The results of numerous analyses, however, show that the air in the immediate vicinity of the humidifiers in this and other rooms in this mill contained 35 per cent. more bacteria than the air 30 or 40 feet away, while the average bacterial content of the air in rooms which contained humidifiers was almost twice as great as that of similar rooms which were not artificially humidified.

TABLE VI.

EFFECT OF HUMIDIFIERS ON GERM CONTENT OF AIR OF MILLS.

Mill.	Type of Humidifier.	Per cent. which counts on samples collected near humidifiers were of those collected 20 to 40 ft. away.			Per cent. which counts on samples in rooms containing humidifiers were of those without humidifiers.		
		Bacteria.		Moulds.	Bacteria.		Moulds.
		20° C.	40° C.		20° C.	40° C	
A.....	Cloth Filter	42	70	11	10	15	37
B.....	Spray	135	270	90	194	104	92
C.....	Spray	125	85	55	140	1,136	237
D.....	Spray	80	95	110	127	122	40
E.....	Spray	4,000	112	100	2,050	11,000	100
F.....	Spray	175	100	50	—	—	—

In two of the mills, B and D, the polluted Merrimack River water was used as a source of supply for the humidifier systems; in three others, A, C and E, the city supply was used, and in Mill F the river water after filtration through high-rate filters without coagulants was used. In the case of Mill A, in which cloth filter humidifiers were used, the greater part of the city water supplied to the cloths was evaporated and the small excess was wasted. With this type of apparatus, moreover, it is not probable that any of the water bacteria could pass into the air so long as the cloths were wet, and the quality of the water could have little effect on the bacterial content of the air. In the other mills, however, only a small proportion of the water supplied to the spray humidifiers was evaporated, the unevaporated water being passed through filters and returned to the humidifiers together with sufficient new water to make up the deficiency. So far as the total bacterial content of the humidified air or of the water

supplied to the spray humidifiers is concerned, little difference is to be observed in the results which can be attributed to the quality of the water. The unevaporated water coming from the humidifiers in any of these mills always contained large numbers of bacteria. The filters provided to purify this water, while they may have satisfactorily removed the lint and dirt which would clog the orifices of the spraying devices, did not in any

TABLE VII.

AVERAGE BACTERIAL ANALYSES OF WATER BEFORE AND AFTER PASSING THROUGH SPRAY HUMIDIFIERS.

	Mill A.	Mill B.	Mill C.	Mill D.	Mill E.	Mill F.
Bacteria per cc., 20°C.						
Water entering humidifiers	22	37,800	15,200	21,000	16,500	2,460
Unevaporated water after passing through humidifiers	334	56,500	5,900	13,000	18,900	2,700
Effluent water filters as returned to humidifiers	—	35,300	16,000	20,500	17,300	2,300
Water used to replenish supply	22	47,500	25	30,000	650	5,500
Bacteria per cc., 40°C. Total.						
Water entering humidifiers	1	258	28	52	49	24
Unevaporated water after passing through humidifiers	6	233	23	50	53	10
Effluent water filters as returned to humidifiers	1	248	28	50	52	22
Water used to replenish supply	1	300	24	80	1	52
Bacteria per cc., 40°C. Red.						
Water entering humidifiers	0	14	12	30	35	3
Unevaporated water after passing through humidifiers	2	0	5	28	28	0
Effluent water filters as returned to humidifiers	—	1	12	28	37	2
Water used to replenish supply	0	252	10	60	0	28

Mill A, cloth filter humidifiers operated with city water.
Mills C and E, city water used to replace water evaporated from spray humidifiers.
Mills B and D, river water used to replace water evaporated from spray humidifiers.
Mill F, river water after filtration through high-rate filter used to replace water evaporated from spray humidifiers.

case show any considerable degree of bacterial efficiency. As a result, the water circulated through the humidifier system was always of high bacterial content, and the small proportion of new water added to replenish that which was evaporated was not sufficient to materially influence the bacterial content of the water in the system. In the case of Mill B, where river water was used, the numbers of body temperature bacteria in the

water supplied to the humidifiers were very much higher than in any of the other mills, but in Mill D in which river water was also used these counts were not appreciably higher than in Mill E where the city water was used.

The average effect of humidification upon the bacterial content of the air and the analyses of the water in the humidification systems of the different mills are shown in Tables VI and VII.

Correction.

In the first portion of this paper printed in the November issue, the following typographical error was made:—

Page 1181, Table I, Average Yearly Deaths per 1,000, should be, Average Yearly Deaths per 100,000.

AN APPARENT MILK-BORNE OUTBREAK OF PARA-TYPHOID.

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The following account of an apparent milk-borne outbreak of para-typhoid which appeared in several semi-urban communities of Greater Boston, during September and October, 1912, seems of sufficient interest to warrant its publication as a contribution to the epidemiology of the disease.

In the early part of September a number of cases of what was called "typhoid" appeared in three neighboring communities. They appeared at a time when "vacation typhoid" might be looked for, and attracted little attention at first, although there was practically no typhoid on record in the communities affected. It soon became evident that the cases were confined to the users of milk from one dealer, and the local Health Departments began an investigation to discover the cause if possible. The dealer, whose milk seemed responsible, did a fairly large business, collecting milk from some twenty-five or thirty dairies within a radius of twenty-five miles, bringing it to a central station where it was mixed and bottled for distribution. The milk reached the consumer not more than twenty-four hours after the milking. He was asked to furnish a list of all his producers, which he did, although there is reason to suppose that he suppressed the name of one, and the dairies were all visited with the result that no cases of illness among the workers could be found, nor were any of the workers of the central station found ill.

The cases still continued to occur, and finally one was found which reacted positively to para-typhoid. Previous to this the cases had given a non-typical Widal, showing good agglutination, but not complete loss of of motility. In some instances careless observers had reported these cases as "typhoid," while in others they were reported as non-typical and a second specimen requested; a request which was seldom complied with. No blood cultures had been made.

Acting on the information obtained from the first positive para-typhoid reaction, other cases were tested for para-typhoid with the result that practically all reacted positively, with certain exceptions to be referred to later.

A second investigation was made with the following results:

(1) It was found that an Italian had been working at the central station up to October 14, when he left. From information obtained it was thought advisable to trace out this man, which was done and the following history

obtained: He had had typhoid fever two or three years ago. On August 22, 1912, he had what he called "grippe" which lasted until the end of September, the symptoms being general malaise and slight fever. He continued at his work during the attack, this work consisting of collecting milk from some of the dairies and washing the cans.

(2) Two cases of illness were found at one of the dairies, a dairy which had not been included in the first list furnished. These cases were called typhoid, and were said to have shown a positive Widal; the first case was said to have developed on September 22 and milk from that dairy had been used by the dealer until October 3.

The problem was to explain an apparent para-typhoid outbreak when the two possible sources of infection were, the Italian, a possible typhoid carrier, and the typhoid cases at the dairy, milk from which had gone into the general supply as late as October 3. It seemed easier to overthrow the diagnosis of typhoid in the second source and perhaps show that the Italian was not a carrier of typhoid.

The local health department, under whose jurisdiction the Italian then was, reported that he reacted positively to the Widal test and that his urine and fæces were negative. He was not tested for para-typhoid. Subsequently it appeared that the reaction with the typhoid broth was not absolutely typical, but that the observer had placed a "?" after his finding. It was not made perfectly clear why this was done.

A second visit was paid to the dairy where the two cases of "typhoid" were and it was found after careful questioning that the man, who had first stated that he had taken to his bed on September 22 had in reality had intermittent diarrhœa, general malaise and slight "fever turns," beginning the last week in July and continuing until he took to his bed. He had attributed his condition to overwork and during the whole period had continued milking his cows, the milk being used until October 3, when it was stopped.

The laboratory where the specimen of this man's blood was examined, in reply to a letter of inquiry, stated that "the test was not typical with typhoid broth (good clumps but not complete loss of motility), but was absolutely typical with alpha-para-typhoid."

From this it appears that this man had para-typhoid and not typhoid and that the possible period of infection of the milk was from the last week in July until October 3.

The distribution of this milk is interesting, for as a rule it was sent directly to certain provision stores in one of the communities affected and not mixed with the general supply. Sometimes when there was a shortage of milk it went into the general supply and was distributed with it. The community to which it usually went had more than half the total number of cases.

The Italian at the central station who had "grippe" from August 22 to the end of September was probably the first case. Here it cannot be shown definitely that the man had para-typhoid. He was said to have shown a positive Widal with typhoid, but as has been stated the observer questioned the finding on his own record, although at first he reported the result as positive. The urine and fæces were negative to typhoid. The fact that he had had typhoid two or three years previously may have caused a non-typical Widal with typhoid. The second case appeared about September 10 in a boy six years of age. This case, which was a non-resident, was not reported to the local board of health at the time, but late in October after his recovery and return home his father wrote, reporting it. It was called "typhoid" at the time but as far as can be learned, the diagnosis was entirely clinical and the case very mild.

As the boy drank the suspected milk, it is fair to assume that it was a case of para-typhoid.

Cases continued to occur from this time until November 6 when the last case was reported.

Here is a range of possible milk infection from a date in July which cannot be fixed definitely but was probably during the last week, to October 3, when the milk was stopped, or, if it is granted that the Italian had para-typhoid, to October 14 when he left work, while the range of cases among the users of the milk was from the third week in August to November 6.

In all, as nearly as can be determined, there were twenty-five cases among the users of this milk, of which number fifteen gave a positive reaction with alpha-para-typhoid, and one, the only fatal case and the last reported, gave a positive Widal with typhoid from a specimen of blood taken immediately after death. This case gave a negative reaction to both typhoid and para-typhoid less than a week before death. No autopsy was obtained.

This case is included in the series because she was a user of the milk and while it is possible that she might have contracted typhoid from another source, careful investigation failed to show any such probable cause.

In partial explanation of the fact that only fifteen out of the twenty-five cases gave a positive reaction with para-typhoid it may be stated that many of them were not discovered and tested until after convalescence, and it was found that the other cases, which gave a positive reaction during the illness, lost it soon after defervescence.

In the few cases which came to hospital treatment, the clinical course of the disease resembled that of a mild attack of typhoid fever. Rose spots were observed in these cases.

It was impossible to determine the period of incubation, as the majority of the cases were habitual users of the suspected milk.

In two instances, however, approximate data are available. In one

case, a non-resident aged six years, the attack developed about ten days after beginning the use of the milk, and in one of the last cases, the first feelings of illness were noticed on November 3, while the last probable infection of the milk was on October 14 when the Italian ceased work.

Summary.

In all there were 25 known and 3 probable cases. Of the 25 known cases, 15 reacted positively to alpha-para-typhoid and one to typhoid.

All the cases, known and probable, were users of the suspected milk.

During the period under consideration there were no other cases of paratyphoid in the communities affected.

In two of these communities, whose combined population by the Census of 1910 was 67,598, no cases of typhoid existed or were reported during the period under consideration.

The milk was undoubtedly infected by the dairyman who was ill during July, August and September.

It could not be determined where he acquired his illness.

He could have infected the milk either directly by contact or indirectly through the water used for washing the utensils, as the privy was about 100 feet distant from the well and on a higher level.

I am indebted to Dr. J. L. Drummey of Watertown, Mass., and Dr. A. P. Mason of Fitchburg, Mass., for information in regard to the outbreak.

THE NEW INTERCEPTING SEWER SYSTEM OF NEW BEDFORD.

WILLIAM F. WILLIAMS, C. E.,

Chief Engineer, Massachusetts State Harbor and Land Commission, Formerly City Engineer of New Bedford.

Read before the Massachusetts Association of Boards of Health, October 9, 1913.

New Bedford has a population at the present time of somewhere in the neighborhood of 105,000. At the time the act was passed in 1910, authorizing the city of New Bedford to spend $1,600,000 for the construction of an intercepting sewer system, the population was about 100,000 and the area was nineteen and one-third square miles. It is a very long city, but is only about two miles in its greatest width and about ten and three-fourths miles in length. At that time the combined sewer systems of the city had a length of eighty-two miles and had cost considerably over a million dollars. Separate sewers had been built for a length of five miles, but there are, of course, the eighty-two miles, at least, of combined sewers to be considered in the creation of a project to take care of the sewage of the city.

Briefly, the city slopes to the Acushnet River, or the harbor and to Clarks Cove. Really the Acushnet River is only a tidal estuary of Buzzards Bay. You have been on County Street twice today, and that street for some distance is a sort of backbone, or ridge, which marks the division of the water shed of the city. Everything to the east of County Street flows to the Acushnet River, and nearly everything to the west flows to Clarks Cove. This is the body of water on which the pumping station and screen station are located. A large proportion of the volume of the city's sewage is discharged into Clarks Cove. The tidal action keeps the water constantly rising and falling, but the prevailing southwest wind forces the sewage to the head of the cove, so that it has been a nuisance for a great many years as it lies there right on the edge of a large residential section of the city. Therefore, the problem was to dispose not only of the sewage but of a considerable amount of rain water collected from this large water shed.

The surface area drained by the combined sewers was estimated to be 4,000 acres, and this was assumed as the maximum area from which it would be necessary to provide for surface water. There are thirty-one sewer outlets in the Acushnet River and eight in Clarks Cove. The salt water was, of course, the natural disposal point for this sewage. If New Bedford had been an inland city, it would have been necessary to devote considerable time to the study of purification and perhaps the city

would have been forced to adopt some one of the various purification systems now in use. It is hardly necessary for me to say to you, professional gentlemen, that the septic tank, the sprinkling filter, the slow sand filtration, and also the Imhoff tank, are only attempts by man to improve upon nature. The oxidation of organic matter by the growth and development of bacteria has been going on so many years that you will not expect me to tell you when it commenced. It is accomplished, we believe, by the operation of a certain amount of oxygen which exists in the atmosphere and in the water, which apparently is not fully occupied. In the air we call it "free oxygen," and in the water "dissolved oxygen." Whatever its condition, it is there, and it is available for the oxidation of organic matter. Therefore, if we can only have an unlimited supply of clean water for sewage to discharge into, we need have no fear of the creation of a nusiance by lack of proper fermentation of the organic matter.

Buzzards Bay seemed amply able to provide an unlimited supply of pure salt water. Fresh water would have been just as good if we had had it, and perhaps better, but it was salt water that we had, so the problem really resolved itself into getting the sewage of the city as far into Buzzards Bay as was possible at a reasonable cost.

The sewers, as I have said, all empty into either the Acushnet River or the head of Clarks Cove. Therefore, the natural way to relieve the situation was to construct an intercepting sewer the entire length of the city, intercepting all the sewers that were already built, and now discharging into the river and the cove, and then convey their combined flow to the sea by gravity.

Owing to the fact that very much of the territory of New Bedford adjoining the waterfront is at a comparatively low level, being in fact only a few feet above tide water, it was necessary to give the intercepting sewer, if it was to discharge by gravity, a very low grade or pitch in order not to leave too large a territory between the sewer and the water front that could not be drained. To this end the grade finally adopted was only .33 of a foot in 1,000 feet. This is a very flat grade, nevertheless the sewer is figured to discharge, under normal conditions, 120,000,000 gallons a day.

Now I want to say a word as to how we arrived at the capacity of this sewer, because it is one of the interesting points and is also one of the fundamental principals involved in designing an intercepting sewer system. It, of course, stands to reason that with the combined sewers taking the rain water of 4,000 acres, an intercepting sewer which would take care of all this surface water would have to have tremendous size or tremendous capacity due to grade and size. It was essential, however, to take care of a moderate rainfall, because, as you know, the first effect of a rain, whether moderate or large, is to flush the sewers of whatever sewage

may have accumulated in them. After that the flow is principally rain water, and it can be discharged into most any body of water without doing any particular harm.

An inch of water on 4,000 acres of land amounts to about 110,000,000 gallons. To this was added 10,000,000 gallons per day for the flow of the separate sewers. A run-off of an inch of water in twenty-four hours may be assumed as the run-off of a rainfall varying from an inch in twenty-four hours to a rainfall of an inch and a half in twenty-four hours, depending upon the character of the development of the territory contiguous to the sewer. Naturally it is one of those things which is constantly growing greater. On a paved street section it comes pretty near to being the whole rainfall.

I said, "We will assume a rain-water flow from these combined sewers of an inch of water in twenty-four hours, which will take care of an actual rainfall from an inch to an inch and a half in twenty-four hours." The great majority of rainfalls, as shown by the records kept for many years, are much below one and one-half inches in twenty-four hours, and, as I said before, the sewer will in any event take care of the first run off of any rain. When the capacity of the intercepting sewer is reached it will discharge its overflow, which will consist of rain water with a small amount of sewage, through certain selected outlets into the river and into the cove. At the point of connection between the regular sewers and the intercepting sewer there will be regulating chambers where the regulation of the flow will be accomplished.

When the sewer is completed to the point to which it is now laid out, which is to Belleville road at the north end of the city, it will have, together with the outlet into the bay, a total length of 36,000 feet. The greatest difficulty at first will be to get enough sewage and water into the lower part of the intercepting sewer to operate it properly, and prevent deposits. Therefore, for a time, all the flow of the sewers in the lower part of the city will be taken into the intercepting sewer. Possibly it might not take all of a very heavy rainfall.

The next step in the problem was to reduce the conclusion to the per capita unit of comparison.

Here is a city of 100,000 people with great expectations as to future growth, nevertheless it was necessary to assume a future population of 300,000 to reduce the figured capacity of the intercepting sewer to about 400 gallons per capita per day. Even this is a little larger than most cities estimate as the sewage flow per capita, but it struck me that I had gone about as high as I wanted to in assuming the growth of population. Therefore, for purpose of comparison in the usual unit of discussion, I have always stated that the system was designed to provide for a run-off of 400 gallons per capita for an assumed population of 300,000, but,

as a matter of fact, the capacity was estimated independently of per capita flow as I have explained.

When this project was referred to Messrs. Metcalf and Eddy and also to Professor Sedgwick and Professor Phelps for consideration of the physical and sanitary side of the problem, I think they were all rather impressed with the feeling that I had made the design full large, and it was suggested that it might be reduced and a considerable saving secured, but I said:

"Gentlemen, the city of New Bedford has a condition which is extremely offensive to its citizens. The waters of the river and the waters of the cove are polluted to such an extent that it will take some time to purify them, even under the most advantageous circumstances. In my judgment it is unwise to take any chances that will imperil the success of the removal of this pollution. It doesn't make any difference if the sewer does appear large; if it will secure the greatest possible removal of sewage from the the waters near the shore. From my experience with municipal improvements I am satisfied that the day may come when we may be criticised for making it too small, but I haven't any fear of ever being criticised for making it too large." Later this view was concurred in by all concerned.

Having settled the question of capacity, it then became necessary to select the exact point in the bay where the outlet should be located. For a number of years we had been making tidal observations in the Acushnet River to determine the extent of the tidal flow, hoping that possibly we might find a location above the extreme end of Clarks Point where the sewage could be discharged without fear of creating a nuisance, but the observations showed there was no such location and we finally carried our investigations into the bay beyond the end of Clarks Point, and at last, with the approval of the State Board of Health, decided upon a location about 3,300 feet off the extreme end of Clarks Point. From this location the floats showed no disposition to reach the shore in any direction. We experimented with every kind of float we could think of or read about and went into the matter very thoroughly. Any kind of float will cover a greater distance than sewage will because they are more affected by the wind. The State Board of Health also carefully studied our data and suggested the location finally adopted, 3,300 feet off the extreme end of Clarks Point in water thirty feet deep.

The outfall portion of the sewer is a cast-iron pipe, 60 inches in diameter, laid by divers in a trench dredged in the bottom of the bay. The outlet is a quarter turn which is laid in a very heavy structure, of concrete and timber, surrounded by rip-rap. The sewage as it is discharged from the pipe comes in contact with a great body of water which is kept in motion by the tidal currents of the bay. It would be a very simple matter to calcu-

late the approximate amount of dilution, but I won't burden you with that because it runs up into very large figures.

At the end of Clarks Point, where the concrete sewer joins the cast-iron pipe, there is a regulating chamber with gates which can be shut when the sewage flow is low and there is danger of sand or sewage depositing in the outfall sewer. At such times the gates can be closed and the sewage allowed to head up in the intercepting sewer. With this head and the added head gained by waiting for low tide, the outfall sewer can be flushed.

There is one other feature of the design of the system which may interest you and that is the provision for screening the sewage and taking out sand. In connection with coarse screening to remove floating matter it was also thought desirable to put in grit tanks to take out the sand which may get into the intercepting sewer from the combined sewers. In spite of the fact that there are the usual catch basins all over the city, a great deal of sand does get into the sewers. We know this from the fact that the city has to spend a considerable amount of money for dredging the docks at the outlets of the present sewers. Therefore the plans call for building a combined screening station and grit station. You saw the foundation of this combined station on the west side of Clarks Point, about 8,000 feet from the outlet of the outfall sewer.

I explained to some of you gentlemen while there that the station consists of three chambers, a central one for the passage of the dry weather flow, as we call it, which will take care of the sewage at all times except in a rain storm, and two chambers, one on each side of the central passage to take the flow when it is raining. There will be two sets of vertical screens in front of each chamber, one set being in operation all the time. These screens, by the way, will be lifted electrically In fact, all the operations requiring power in this plant will be performed electrically.

At the entrance to each chamber is a cast-iron sluice gate, which will also be operated by electric hoists. With these gates any chamber or all of the chambers can be closed, and in an emergency the sewage can discharge direct into Clarks Cove by an overflow north of the building. During a rain storm the sewage will be diverted from the central passage through one of the grit chambers. The bottoms of these chambers are about six feet below the invert of the sewer. There is also a slight enlargement in width. These conditions check the velocity of the sewage and, if the sand does as it ought to under these conditions, it will be deposited, thus separating itself from the lighter organic matter of the sewage.

The usual operation of grit chambers is to allow them to fill up and then excavate the deposited material. But under these conditions considerable sewage is retained in the chamber which soon becomes very offensive. This station is designed to try another device. Some of you—perhaps many of you—have seen the sand washers that are used in the sand filtra-

tion plants of water systems of such cities as Philadelphia, Washington and Pittsburgh. The sand from the filter beds is passed through an apparatus where a large amount of water is mixed with it, separating the organic matter which goes to waste through an outlet while the sand is passed right back upon the filter beds washed perfectly clean. It is intended to try to do the same thing with the sand taken out of these grit chambers. Furthermore, it is hoped that the sand can be taken out almost continuously during the period of a rain storm by means of sand pumps, so called, that work on the principle of an ejector, using water under pressure instead of steam. If it works successfully the washed sand will be used for filling and the wash water and sewage will pass back into the sewer and flow off to sea. If it doesn't work, the chamber will be allowed to fill up in the ordinary way, and the sand and organic matter taken out by some device like the clam-shell bucket and discharged into scows which will be towed to sea. When one chamber is being cleaned the other will be in operation, therefore it does not cause us any serious concern even if the other scheme will not work, but we hope that it will.

In addition to the provisions for screening and for separating the sand in the sewage the city secured the advice of Professor Sedgwick and Professor Phelps upon the disinfection of the sewage to prevent the contamination of sea food. These gentlemen gave the question careful study and made a report recommending that the city provide facilities for adding a solution of bleaching powder to the sewage before it is di-charged into the bay. This will be added at the lower end of the station, after the sewage has passed through the screens and sand chambers and is on its way to the bay. A room will be provided with the equipment for mixing a solution of bleaching powder and adding it to the sewage in whatever volume is necessary. The details of this part of the plant have not yet been completely worked out, although they are tentatively decided upon. The principal difficulty will be to obtain some device that will automatically adjust the percentage of bleaching powder to the varying degree of dilution of the sewage, from the concentrated sewage of dry weather to the diluted sewage during a heavy rainfall. This problem has yet to be worked out, but I think it can be done.

One other point in connection with this sewer will be of some interest, although I am not going into it in detail as it would take a long time and I am afraid you would get very tired. There are certain low level sections of the city, contiguous to the intercepting sewer, that cannot be drained by gravity. These sections are also hampered at the present time by the fact that they are altogether too low to properly drain existing cellars and with heavy rains and a high tide they are flooded. It is proposed to take care of these low level sections by small independent pumping stations, which will collect the sewage and pump it into the intercepting

sewer. The Clarks Cove pumping station is built and you have seen it. This station has two eight-inch centrifugal pumps, driven by induction motors, with room for two more larger pumps. The estimated ultimate capacity of this station will be about 13,000,000 gallons in twenty-four hours. The plans also call for another station farther north in the locality of Howland and Water Streets which is near the point where you first saw the intercepting sewer. This station will take care of quite a low section of the city and farther north another station will be built. These stations will not be made quite as elaborate as the Clarks Cove station which you saw. That station is in a locality where it might create unfavorable criticism if the city had undertaken to build too economically and thus fail to avoid the disagreeable features that might be connected with the material it was to deal with. So it was decided to make it as attractive as possible. The plan also provides adequate means for the ventilation of the chambers by fresh air inlets underneath the floor and a connection between the sewage well and the chimney. We leave it to you, gentlemen, to say how well we have succeeded in keeping down offensive odors and in making the building look attractive. But the next station, being smaller, will be built entirely underground, so that to the eye there will be nothing to suggest a pumping station. A tank or receiving reservoir will be built in the middle of the street, and the pump chamber will be under the sidewalk. There will be only an ordinary plate in the sidewalk covering the point of entrance to the pumping station.

All these stations will be operated automatically. The apparatus in the station you saw is made by the General Electric Company. I will not take the time to describe it in detail. The apparatus is operated by floats rising and falling in cast-iron pipes placed vertically in the sewage well.

As I stated to you in the first place, I have not attempted to present to you a carefully prepared paper, but have rather trusted to my memory to tell you the essential details of the work.

In closing I desire to say that I appreciate the honor you have done me by asking me to speak to so large a body of professional men, and men so intimately connected with the sanitary welfare of this Commonwealth.

THE PREVENTION OF TYPHOID FEVER IN THE RURAL DISTRICTS OF VIRGINIA

ALLEN W. FREEMAN, M. D.,
Assistant Commissioner, Virginia State Health Department.

Read before the General Sessions, American Public Health Association, Colorado Springs, September, 1913.

The campaign for the prevention of typhoid fever in the rural districts of Virginia, which has been carried on by the Virginia State Health Department since its reorganization in July, 1908, has been based on the conclusions regarding rural typhoid in Virginia presented to this Association in a previous communication by Dr. L. L. Lumsden and the writer.

Those conclusions were:

1. Typhoid fever of the rural districts of Virginia is largely a matter of the summer months, appearing quite regularly at the beginning of June and ending usually about the middle of September.

2. In the winter months, localized water-borne outbreaks of the disease sometimes occur.

3. In the summer months the influence of water in the transmission of the disease is not apparently of great importance.

4. Direct personal contact with the sick, particularly in those nursing the patients is an important means of spread of the disease.

5. Milk and foods of various kinds coming from infected houses frequently carry the infection.

6. General dissemination of human fæces, particularly by the fly and on the feet of fowls and domestic animals is an important means of spread.

7. Mild cases of typhoid infection, clinically unrecognizable, serve frequently as distributors of the infection. Such cases probably occur in considerable numbers wherever typhoid is prevailing.

The prevention of typhoid fever in the rural districts of Virginia, while a matter of great difficulty and of necessity requiring many years for its accomplishment, rests, we believe, on the following simple elements:

1. The general education of the people as to the nature and means of spread of the disease, particularly as to the dangers of contact and food infection.

2. The isolation of the sick and the disinfection of the excreta together with the bed and body linen.

3. Recognition of human excrement as the most dangerous material on the farm, and so providing for its care and disposal that it be kept off

the ground, in a water tight receptacle, screened against flies and animals, until burned, disinfected, buried or otherwise safely disposed of.

The recognition of human filth as the source of the infection, and the avoidance of all fecal contamination, whether by flies, food, clothing, hands, water, or any other means whatever, constitutes the one and only precaution necessary for the absolute prevention of the disease.

In the campaign of prevention, we have deemed it absolutely essential that the average citizen be accurately informed regarding the means of spread and of prevention of typhoid fever, and for this purpose have carried on a continuous and active campaign of popular education regarding typhoid fever. The bulletin on typhoid fever, originally issued in 1908, has been twice rewritten and republished and a total of nearly two hundred thousand copies have been circulated.

In addition to the bulletin devoted especially to typhoid fever, various other bulletins have carried more or less extensive articles on the disease and probably more than half a million simple and easily comprehensible articles on typhoid fever have been placed in the hands of the lay readers of Virginia.

For the purpose of attracting the attention of those to whom our bulletins did not originally go, posters were prepared and issued calling attention to the salient facts. Ten thousand of these were posted in post offices, railroad stations and country stores.

The regular press service of the State Health Department has carried more than fifty notices regarding the prevention of typhoid fever, printed in practically every county and most of the city papers of the state.

The campaign of printers' ink has been supplemented by a lecture campaign, in which every county in the state has been reached and practically every community has received one or more lectures, frequently illustrated by the lantern, on the disease.

By this means, every citizen of Virginia has had the simple fact that typhoid fever is spread by the dissemination of human excreta and can be prevented by stopping that spread, laid before him, not once only, but over and over, and from many angles. The state has been completely evangelized with the gospel of fecal conservation. In addition to this widespread evangelization, we have endeavored to reach the bedside of the individual case. Every doctor in Virginia has been appealed to, over and over again. Bedside directions, in the most convenient form, have been furnished him for distribution and no stone has been left unturned to get the doctor to institute bedside prophylaxis.

The fly has been the object of sustained attack. Bulletins, press notices, lectures, moving picture films and swatting campaigns have all been utilized.

But the crux of the whole campaign, the one element by which the whole structure will stand or fall, has been the campaign for the sanitary privy. In this work, the forces concerned with hookworm eradication have been of immense service.

For the purpose of gaining exact information of existing privy conditions at country homes, a sanitary survey has been undertaken. Sixty-seven out of the one hundred counties of the state have been surveyed and 13,495 country homes inspected. Upon the information thus gathered has been based the campaign for the sanitary privy. In the three years of the hookworm work, 1,862 public lectures have been delivered to 180,000 persons on hookworm disease and the sanitary privy.

The State Department of Agriculture has aided materially in the work. A lecturer on farm sanitation has traveled with the farmers' institute trains and more than 20,000 farmers reached by this means alone. The State Board of Education is coöperating in the work of securing two sanitary privies at each of the 9,000 public school houses of Virginia and this work will, in all probability, be completed in 1915. One hundred and fifty thousand copies of the department's leaflet on the sanitary privy and 55,000 of the Lumsden-Stiles bulletin of the Federal Department of Agriculture have been distributed in the rural districts of the state.

In furtherance of the work, a sincere effort has been made to secure the education of our people regarding the dangers of impure water and the means of securing proper water supplies on farms. Two bulletins on good water have been issued in addition to numerous press notices and other literature.

In addition to this somewhat extensive campaign of education and evangelization, more direct methods have also been employed. The epidemiologist of the department is, of course, always available for epidemic work, but in addition during the summer months a typhoid field force is organized for work in small towns and rural districts. Investigation of typhoid conditions is made on request of local authorities or as soon as undue prevalence is disclosed in any community. In these investigations effort is made to determine the means of spread of the disease and to formulate proper procedures for controlling it. The visit to the infected house made necessary by this investigation is, of course, utilized to inspect bedside prophylaxis and to insure its accurate practice. It has been possible, using the same forces year after year, to standardize the work and to investigate practically every outbreak of more than five or six cases in any rural district.

The investigation of the causes of spread of typhoid fever begun in 1911 and reported in part to this Association were continued in 1912 and completed in 1913. The results will be reported in another place.

In addition to education, investigation and direct means of prevention,

we have been much interested during the past year in the use of typhoid vaccine in members of families in which there is a case of typhoid. This was extensively used in the summer of 1913 with uniformly good results. We hope to secure large extension of this method of prevention in coming years.

The results of this campaign have been evident. The interest of the people at large in the prevention of typhoid has been greatly increased and their knowledge of the means necessary to this end enlarged. Bedside prophylaxis has undoubtedly been wonderfully improved. The campaign for the sanitary privy has begun slowly to show results in the building and use of the types recommended by the department. Most important of all, the number of cases, reported and estimated, has shown steady and decisive decline, as shown by the table:

Year. October to October.	Cases.	
	Reported in State.	Estimated in State.
1908–1909	7,700	13,069
1909–1910	6,771	11,843
1910–1911	5,959	11,803
1911–1912	4,608	8,480

It is to be regretted that our registration law which went into effect in June, 1912, has not been in operation sufficiently long to give statistics of value on this point.

We believe that when every citizen of Virginia knows the simple, essential facts about typhoid fever, when bedside prophylaxis is universal, the sanitary privy in general use, every outbreak promptly investigated and vaccination of exposed persons practised without delay, we will make typhoid fever in rural Virginia a rare disease and we are working, confident of ultimate success, to that end.

REPORT OF COMMITTEE ON WATER SUPPLIES.

Read before the Sanitary Engineering Section, American Public Health Association, Colorado Springs, September, 1913.

The instructions to the committee indicate that it is desired to have a report setting forth some of the more important topics for discussion in this general field, together with such preliminary or final reports on special aspects of the broad field as it may see fit.

This committee has no final report to make upon any topic.

It mentions briefly six features of water supply developments which are considered to be among those of most educational value at this time, as follows:

Hygienic aspects.
Rate of installation of filters.
Sterilization.
Decolorization with overdose of coagulant.
Decolorization as an adjunct of softening.
Corrosion of metals.

Other topics are, of course, interesting and progress in them is being made. The topics outlined in this report, however, with the discussions of details that are hoped for at the convention, should fully occupy all the time available for water supply matters and lead the way for more definite committee action another year.

No attempt is here made by this committee to enter into the field of pollution of water supplies by either municipal or trade wastes. It is assumed that this field will be taken care of in due time by other committees. For the present it is the feeling of this committee that substantially all surface water supplies should be filtered in order to be of satisfactory quality. There are some exceptions to this rule, but the conditions surrounding these exceptional supplies depend so much upon local factors that there can be no ready classification of their characteristics.

The Hygienic Aspect of Public Water Supplies.

Notwithstanding the sterling hygienic worth of modern filters, as set forth in numerous official reports, articles in technical papers and authentic statements in text-books, there are published from time to time individual opinions to the effect that filtration works produce little or no favorable influence upon the public health of the community enjoying them. It is well for sanitarians to keep clearly in mind the splendid record made at the large number of filter plants which treat polluted surface waters so that the quality of the effluent is hygienically above reproach and so

that the vital statistics of the water consumers are as favorable as those in communities similarly situated which receive water of unquestioned purity either from underground sources or from uncontaminated mountain areas. In this connection attention is called to the typhoid fever statistics from certain northern cities equipped with modern filtration plants, as follows:

ANNUAL AVERAGE DEATH-RATES FROM TYPHOID FEVER PER 100,000 POPULATION.

City.	Plant Completed.	Years in Average.		Typhoid Fever Death-Rates.	
		Before Filtr.	After Filtr.	Before Filtr.	After Filtr.
Mechanical Filters.					
Binghamton, N. Y.	1902	5	5	47	15
Cincinnati, Ohio	1907	4	4	50	12
Columbus, Ohio	1908	11	3	78	11
Hoboken, N. J.	1905	7	6	19	14
Paterson, N. J.	1902	5	9	32	10
Watertown, N. Y.	1904	5	7	100	38
York, Pa.	1899	2	12	76	21
Sand Filters.					
Albany, N. Y.	1899	9	9	74	22
Lawrence, Mass.	1893	7	15	114	25
Washington, D. C.	1905	5	6	57	33

There are other intestinal diseases beside typhoid fever which are transmitted by water supplies, and which show low death-rates in instances where a community is supplied with good water. How far a good water supply affects the general health tone of a community as reflected by vital statistics in diseases other than those of the intestinal group is a matter upon which information is not conclusive owing to the variation in data obtained from various cities. Evidently the accuracy of the classification of the causes of deaths is a factor in weighing the statistics. It is an important field for investigation.

That typhoid fever and other intestinal diseases known to be sometimes water borne are due at other times to inadequate sanitary conditions other than the public water supply is, of course, well known. The subject has

been well studied at Washington, D. C. The influence of other factors than the public water supply is particularly striking in the southern cities. For instance, at New Orleans, there is one of the best filter plants in this country, operated in a very efficient manner and producing filtered water of highest hygienic quality. Notwithstanding this, the vital statistics show that New Orleans did not enjoy until last year a very low typhoid fever death-rate and that the New Orleans rates are not low in other diseases more or less related to the public water supply. The following statistics throw light upon this question:

ANNUAL TYPHOID FEVER DEATHS PER 100,000 POPULATION IN NEW ORLEANS, LA.

Before Filtration.		*After Filtration.*	
1904	36	1909	29
1905	32	1910	32
1906	30	1911	31
1907	55	1912	14
1908	29		

Even higher death-rates from this disease are to be found at Atlanta, Ga., and Birmingham, Ala., where filter plants of quite modern design are in use.

The report for the year 1912 of the Sewerage and Water Board of New Orleans contains a discussion in considerable detail of the sanitary effects produced in New Orleans by the introduction of the new drainage, sewerage, and waterworks systems. Conditions are unusual in New Orleans in that the public water supply has never given indication of being appreciably polluted, if at all. This seems to hold true not only of the present filtered supply from the new city plant, but also of the unfiltered Mississippi River supply furnished by the old plant of the water company prior to 1909, as well as of the individual supplies obtained from cisterns. Typhoid fever in New Orleans apparently never assumed large proportions, and local data indicate that a large share of the cases resulted primarily from importations, some of which produced local foci of the disease, resulting in the spread of the disease through flies, milk, and the food supply during the days when there was a lack of sewerage and drainage facilities, as well as of proper care in disinfection. It seems to be the custom for typhoid patients in various parts of Louisiana and Mississippi, and even more distant states, to be sent to New Orleans, particularly to the Charity Hospital there. The control of this disease at its point of origin is of course beyond the jurisdiction of the New Orleans authorities, who have, however, to deal with the problem of preventing the spreading of the disease within the city, whether the various foci relate to an imported case or not.

Among the many interesting features developed at New Orleans, mention may be made briefly of the fact that in a city having a population of at least 354,000 and with at least 75,000 premises there were at the end of

1912 only about 28,500 premises connected with the sewer system and 46,000 premises connected to the new waterworks system.

The present drainage system, on the other hand, was put in service in 1900, and from the outset had very nearly its present capacity and efficiency. Before its installation storm water could be removed only to less than one-third the extent of the present system, with the result that all the drainage channels formerly stood nearly full all of the time; and small rains flooded the ground at numerous points so that the ground was constantly supersaturated. The installation of the drainage system showed itself at once through the lowering of the general death-rate of the city, which, prior to 1900, had ranged for individual years from 24.1 to 30.2 per 1,000 population, averaging 27.2. During the first ten years, 1901–10, after the installation of the present drainage system the annual general death-rate ranged from 23.6 to 20.3 and averaged 22.1 per 1,000 population. The general death-rate in 1911 was 20.4 and in 1912 it was 20.1.

Malarial fever is one of the diseases that was materially lessened as a result of the new drainage system at New Orleans. From 1891 to 1900 the average annual death-rate per 100,000 population was 104. For the ten years after the opening of the drainage system the annual rate was 20. In 1911 and 1912 the death-rates per 100,000 population were 9 and 8, respectively.

What is said above for New Orleans doubtless applies to other southern cities, showing that typhoid fever and other diseases relate essentially to means of preventing a spreading from local foci due to fleas, insects, and other ways of infecting food supplies. Important work along these lines has been done at Richmond, Va., Jacksonville, Fla., and other places.

Rate of Installation of Filters.

A table was presented before the International Congress of Hygiene and Demography in Washington in 1912 by Mr. Allen Hazen, giving the population supplied with filtered water for several decades, and to which we have added figures for the current year, as follows:

Year.	*Total Population Supplied with Filtered Water.*
1870	None
1880	30,000
1890	310,000
1900	1,860,000
1910	10,806,000
1913	13,290,000

During the period 1904 to 1913, works were built for supplying filtered water to the following cities of 100,000 population or over:

City.	*Population.**
Philadelphia, Pa	1,549,008
Pittsburgh, Pa	533,905
Washington, D. C	331,069
Indianapolis, Ind	233,650
Providence, R. I	224,326
Cincinnati, Ohio	364,463
New Orleans, La	339,075
Hackensack, etc., N. J	250,000
Louisville, Ky	223,928
Columbus, Ohio	181,548
Toledo, Ohio	168,497
Atlanta, Ga	154,839
Birmingham, Ala	132,685
Scranton, Pa	129,867
New York, partial	100,000
Minneapolis, Minn	301,408
Grand Rapids, Mich	112,571

A number of cities in Canada have also, within the last few years, built or are building water filtration plants. Among these are:

City.	*Population in 1911.*
Montreal	470,480
Toronto	376,538
Saskatoon	12,004

Steps have also been taken in the direction of water filtration plants at

Ottawa	87,062
Hamilton	81,969
Brandon	13,839

A number of cities in the United States have in the last year or so either placed contracts for or have been seriously considering filtration plants, the principal ones of which are:

City.	*Population.**
New York City (Boroughs of Manhattan and Bronx)	2,762,522
Hartford, Conn	98,915
Baltimore, Md	558,485
St. Louis, Mo	687,029
Trenton, N. J	96,815
Erie, Pa	66,525
Decatur, Ill	31,140
Dallas, Texas	92,104
Akron, Ohio	69,067
Quincy, Ill	36,587
Evanston, Ill	24,978
New Brunswick, N. J	23,388

* U. S. Census for 1910.

The question has been agitated at numerous other places, the chief cities being those on the Great Lakes, including Milwaukee, Cleveland and Detroit.

STERILIZATION OF WATER: PROGRESS AND LIMITATIONS OF PROCESSES.

The possibility of the sterilization of water by means of hypochlorite of lime, or other similar chemicals, has been known for many years and it has been experimented with and used to a limited extent abroad. Its first application on a large scale for the purification of a municipal water supply in the United States was at the Boonton reservoir of the Jersey City Water Supply Company in 1908. Its use at that time and place brought it conspicuously before the public, owing to the fact that it was made the principal argument in an important litigation in the courts. Following this it came into general use in every part of the United States and Canada, until at the present time it may be said, without exaggeration, that where a municipal water supply is subjected to treatment of any kind, the use of hypochlorite is almost always a part of that treatment. This very general use is quite justified by the results obtained.

A great accumulation of evidence shows beyond doubt that it is a very cheap and quite effective method, generally speaking, for destroying certain of the dangerous elements of a polluted water supply, and every credit is due to those who first adapted it to this use and to those who have developed it to its present state.

The tendency at first was to regard this as a panacea for all troubles arising from polluted water supply, but this tendency was not very long lived. It soon was made apparent to those who had taken the lead in the development and use of this method that it had well-defined limitations, and that, while it was most useful and efficient under proper conditions, if these limitations were overlooked it was likely to be inefficient and disagreeable to the water consumers. A portion but not all of these limitations were related by Mr. George A. Johnson in a paper before the Milwaukee meeting of this Association in 1910.

The treatment of water by hypochlorite does not remove turbidity nor color, nor organic matter to any appreciable extent, nor does it remove objectionable tastes or odors. Suspended matter in the water to be treated interferes seriously with the efficiency of the treatment by the absorption of a considerable part of the chemical in the suspended matter, and also by the fact that the chemical does not affect the bacteria which may be enfolded with particles of suspended matter.

Latterly it has been recognized more and more that the treatment fails to destroy certain kinds of bacteria which, owing to their spore-forming characteristics, are very resistent to the toxic effect of the chemical. There is considerable evidence, too, to indicate that this treatment, as applied

in the United States, does not actually destroy all of the bacteria, but simply stuns them or drugs them for a time, or in other words, has a toxic effect which prevents them, for the time being, from developing on the ordinary culture media.

That hypochlorite has a disagreeable taste and odor is, of course, commonly known. The quantity in which it has to be applied to produce the desired effect in a polluted water is very small; ordinarily small enough so that it does not impart any of this taste or odor to the water treated. Every water, however, has its own limitations in this respect, and experience with a number of waters has shown that practical difficulties sometimes arise in producing the effect desired without leaving the water with seriously objectionable qualities. In such cases the treatment has to be under an unusually careful chemical supervision to prevent offensive conditions. Treatments have been developed and applied which are designed to remedy such offensive tastes and odors, but are not yet generally used for the reason probably that they are not frequently needed. The treatment in this country differs radically from the treatment in Europe in this respect. In some places abroad the dose is relatively heavy, imparting to the water an excess of the chemical and an offensive taste, and after a short period of contact a corrective is applied to remove this excess and to eliminate the objectionable taste. In the United States, on the other hand, the aim has been, in general, to apply only so much, or rather so little, of the chemical as will produce the desired bacterial reduction without imparting any objectionable tastes, and to a large extent this has been successfully accomplished.

From the foregoing it will be seen that hypochlorite treatment must not be considered as a substitute for other established means of water purification. It is valuable, indeed, in many emergencies, and valuable always as an adjunct to filtration. In some waters which are unusual in their freedom from suspended and organic matter, it may be considered all-sufficient, but the principal applicability of the treatment is for emergency use or as a finishing process after filtration.

Liquid Chlorine. The use of liquid chlorine as a sterilizing agent has recently come to public notice. At the present writing its use has not become general enough to afford decisive evidence that it will have the same practical success that the hypochlorite treatment has had. Its advocates make very promising claims for it and the little evidence that has been presented to the public indicates that it is worthy of careful consideration and study. It is said to be quite as efficient, if not more so, than hypochlorite and so far as the chemical itself is concerned, is also said to be more economical.

Ozone. Ozone, which is a combination of oxygen in one of its most readily available forms, has long been known as a good disinfectant. Much ex-

perimenting has been done to make it applicable to the sterilization of water. The results of laboratory experiments along this line offer an alluring prospect, as there is no doubt that under proper conditions ozone has the power to completely destroy bacterial life in water. The commercial application of ozone has been industriously pursued by a number of these experimenters, but the evidence seems to show that they have met with certain difficulties hard to surmount if it is to compare favorably in all respects with other means of sterilization. Principal among these is the difficulty of obtaining a thorough and intimate mixture of the ozone gas with the water to be treated, to be sure that a suitable amount of the gas comes in contact with every particle of water, and of the interruptions in the continuity of performance of the ozonizer. Another difficulty seems to have been the high cost of the treatment when compared with the modest cost of hypochlorite. Also, the treatment is not applicable to water which contains turbidity or organic matter as the presence of these interferes with its efficiency.

Violet Rays. Somewhat the same remarks may be made about the use of violet rays for the sterilization of water as those given above regarding ozone. Its use has been advocated and its success, on a laboratory scale, has been well demonstrated but its excessive cost, its complicated nature and the difficulty of making it applicable to the treatment of large volumes of water, together with the other general limitations already referred to, do not at present promise well for its commercial success.

An unusual opportunity presents itself to this Association to make a comprehensive study of the whole subject of the sterilization of water in the present state of the art.

This should aim to bring out data as to the rate of application, and how it is affected by such conditions as color, turbidity, temperature, etc.; data as to limitations by which actual experience has shown it to be affected, such as reduced efficiency due to the presence of turbidity or color, limits to the amounts that can be applied to any water as governed by æsthetic consideration, inability to destroy certain types of bacteria, such as spore formers, apparent revivification of bacteria after prolonged period of growth on culture media and the possible bearing of this subject upon the hygienic efficiency of the treatment, reduced efficiency due to the presence in the water of reducing agents, etc.; data as to experience with other disinfectants than hypochlorite of lime, such as hypochlorite of soda, hypochlorite prepared electrolytically, liquid chlorine, ozone, violet rays, etc.

The Economical Advantages of Decolorizing Soft Water Through an Overdose of Coagulant as Practised at Springfield, Mass.

The use of aluminum sulphate for the removal of coloring matter from water has become familiar through the development of modern mechanical

filters. It has been practised successfully for many years and has come to be looked upon generally as the logical and most easily applicable remedy for the objections arising from the presence of vegetable stain.

Experience that has been corroborated with the majority of municipal supplies subjected to this treatment has indicated that a color of 100 in some cases may be removed, to a satisfactory degree, by the application of about two grains per gallon of aluminum sulphate. This ratio varies somewhat with individual cases. The color of some waters is discharged quite easily, while others, particularly the hard waters, resist the action to a considerable extent.

As a rule, decolorization is not the primary purpose of the application of coagulant to municipal water supplies. It is more commonly an incident of a treatment, the principal object of which is to remove bacteria which are detrimental to the health. In the practical operation of filter plants, however, the satisfactory elimination of the color dissolved in the water implies an efficient removal of the bacteria as well, and thus it happens that the color of the filtered water is often made to serve as the criterion by which to judge of the satisfactory action of the coagulation treatment.

Cases are uncommon of municipal supplies in which coagulation is resorted to solely for its decolorizing properties. Springfield, Mass., is one of these. When the new water supply for the city of Springfield was developed a few years ago, provision was made for the occasional application of aluminum sulphate, primarily for the purpose of color removal at times when the raw water had a relatively high color. In the practical handling of this treatment it was discovered that the desired decolorizing effect could be produced with entire satisfaction by dosing the water intermittently. The coagulant is applied as the water enters the sedimentation basin. This continues for several hours, the water thus treated mixing with the water previously contained in the basin which, owing to the intermittent application, may be assumed to have received an insufficient dose of coagulant, or perhaps none. The entering water has received an application of coagulant which virtually amounts to an overdose for the water thus treated. Upon mixing after a proper predetermined period of treatment, action takes place which results in a satisfactory reduction of color throughout the whole mass, and with an average application of coagulant which is unprecedentedly low for working conditions. During seven months of 1912 an average application of 0.23 grain per gallon of aluminum sulphate reduced the color from an average of 37 in the raw water to 15 in the filtered water.

The chemistry of coagulation is very complex. Formulæ are often written in the conventional manner purporting to represent the changes that take place upon the application of aluminum sulphate to water. They may be true as far as they go, but it is safe to say that they do not tell the

whole truth. It has long been recognized, for instance, that a considerable proportion of the chemical may go quite unaccounted for in this reaction so far as effective work is concerned. It is a fact too that decolorization may take place, and in fact does take place, with the expenditure of smaller amounts of coagulant if there is no alkalinity present, whereas the conventional formulæ include alkalinity as one of the essential factors of the reaction.

Mr. George C. Whipple, in a discussion of the subject of "Decolorization of Water," before the American Society of Civil Engineers in 1901, pointed out the fact that less coagulant was required to discharge a given color from soft water than from hard, and that instead of two grains of sulphate of alumina to remove a color of 100, only about 0.7 grain was required if there was no alkalinity present.

It is believed that two factors contribute to the success of this intermittent treatment under Springfield conditions.

First, the water is very soft, having an alkalinity which averages hardly more than 10 parts per million.

Second, the sedimentation basin, in which the mixing of coagulated and uncoagulated waters takes place, has a capacity much greater than is commonly found in coagulating basins of mechanical filter plants, namely, about 40,000,000 gallons per day for an average daily flow of slightly more than 10,000,000 gallons. This gives ample time for the reactions which result in the discharge of the color. In the presence of ample amounts of substances involved, the interchange between alkalinity in the water and the coagulant, as indicated by the conventional formulæ, takes place reasonably quickly with consequent prompt decolorization; but the obscure reactions involved in decolorization in the absence of alkalinity or in the presence of only small amounts of alkalinity or coagulant, are very slow.

This method of treatment is suggestive of possibilities in the direction of economy in the decolorization of water where conditions favor it, and is a matter which is deserving of careful study wherever the opportunity presents itself. The success of the method depends upon more or less obscure laws of physical chemistry, which it is hoped may be explained more fully in their bearing upon this question in the discussion by those who developed this method of treatment.

Decolorization as an Adjunct of Water Softening.

During the past year the water softening plant at Grand Rapids, Mich., has been put in service. It deals with a highly colored and moderately turbid water, having a total hardness of about 250 parts per million. The incrustants or permanent hardness amount to only about 30 parts per million.

It was the original intention with the Grand Rapids project to secure a water having a total hardness of roughly 120 parts per million, or approximately that of the water of the Great Lakes. It has been frequently spoken of as the so-called "Lake Michigan" standard.

No soda has ever been used at the Grand Rapids plant, but there is applied about one-half grain or so per gallon of sulphate of alumina to the softened water in order to lessen the turbidity of the water reaching the filters.

The most interesting feature of the Grand Rapids project is that the lime which is used for softening the water also succeeds, through the removal of magnesia, in reducing the vegetable stain to a point as low as that which could be secured at much greater expense by the application of sulphate of alumina. In other words, a highly colored water that is hard is reduced in color to less than 10 parts per million with the use of lime and its total hardness is reduced to less than 100 parts, all at a cost of less than would be required for treatment with sulphate of alumina to secure equal decolorization.

The use of excessive quantities of lime, such as proposed at London by Dr. Houston, for sterilizing water supplies, has not been tested in this country so far as we know. In such a project as that at Grand Rapids it is feasible, however, to secure a high degree of bacterial removal by applying all of the lime to a portion of the water to be filtered. Then the lime-treated water is mixed before filtration with the remainder of the supply which can be sterilized with hypochlorite of lime. The additional possibilities of treating the supply along these lines have not been worked out, but offer a promising field for practically complete sterilization of hard waters at a cost not above that for softening as ordinarily applied.

Corrosion of Metals.

During the past few years technical knowledge upon this subject has increased materially as is also true of observations as to practical experiences.

In general, hard waters have given little or no trouble in corroding metal pipes apparently due in considerable measure to the formation of protective coatings upon the metal by the water itself.

Soft waters do not seem to form naturally such coatings and, therefore, allow the carbonic acid in the water to dissolve such metals as iron and to retain the iron in solution. This process is carried on through the presence of atmospheric oxygen in the water ultimately to a point where all of the oxygen is utilized by the dissolved metal.

Waters which have been softened through the use of lime and from which the free carbonic acid has been removed seem to give little or no trouble so far as attacking iron is concerned. If there should be an excess of lime water used, on the other hand, there is some likelihood of corrosive tendencies noticeable particularly with respect to zinc and galvanized surfaces.

The Water Department of New York City has studied recently and at great length the corrosive properties of the Croton water, particularly as influenced by the use of sulphate of alumina for purposes of decolorization. The free carbonic acid naturally present in such surface waters as the Croton supply is increased somewhat by the carbonic acid liberated through the application of sulphate of alumina. As small quantities of free carbonic acid, however, seem sufficient to institute corrosive tendencies of the water upon iron, the effect of added quantities, resulting from the use of sulphate of alumina, has been comparatively small.

A large share of the investigations has been devoted to the use of lime or soda to remove free carbonic acid and thus reduce the corrosive tendencies of the water. In fact, this process judiciously applied seems capable from laboratory experiences of forming coatings on the inside of a pipe system so that corrosion may be practically neglected.

Clear waters, such as those coming from underground sources and filtered surface waters, show an amount of iron dissolved from the piping which is probably no greater than that which occurs with many turbid and colored surface waters. But when the latter are used in an untreated condition the effect of corrosion seems to have been largely obscured by other physical characteristics. Hence the rapid increase in the use of filtered water has developed the need for additional care in the study of filtration projects.

The New York City investigations above mentioned were conducted by Drs. Jackson and Hale of the Mount Prospect Laboratory of the Water Department, and the same will appear in full in the 1912 Report of the Department.

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DISCUSSION ON CORROSION OF METALS.

FRANK E. HALE.

The question of corrosion of iron pipes by water supply was given an extended investigation of six months at Mt. Prospect Laboratory during the first half of 1912. These experiments are the basis for the following discussion.

CHEMICAL REACTIONS.

In order to understand the problem it is necessary to have a clear conception of the chemical reactions taking place. While the electric theory of solution tension of iron may be correct as the ultimate source of corrosion it is my belief that the cart has been put before the horse and that the electrical phenomena result from the chemical action. Certain it is that the presence of carbonic acid is the most potent factor, coupled with the presence of dissolved oxygen. The action of these two agents is modified by the presence of other salts, increased

by nitrates which furnish oxygen by reduction, decreased by carbonates which help to form protective coatings upon the pipe.

The chemical action takes place in the following order:

Solution as bicarbonate. The first reaction is the solution of iron as bicarbonate by carbonic acid with the formation of hydrogen.

$$Fe + 2\ H_2CO_3 = FeH_2(CO_3)_2 + H_2$$

Formation of hydrogen. The dissolved oxygen in the water which is near the iron surface oxidizes some of the hydrogen back to water. After the oxygen near the iron is used up the hydrogen remains as a gas. In the cold reaction of our experiments the amount of hydrogen oxidized was found to be about 20 per cent.

Oxidation and precipitation of dissolved iron as Fe_2O_3. The dissolved oxygen at the same time oxidizes the soluble iron bicarbonate to insoluble red iron oxide setting free again the carbonic acid.

$$4\ FeH_2(CO_3)_2 + O_2 + 4\ H_2O = 2\ Fe_2O_3 + 8\ H_2CO_3$$

Catalytic action of carbonic acid. The carbonic acid, set free, again dissolves more iron and is again set free until all of the dissolved oxygen is exhausted.

Oxidizing power of Fe_2O_3. The red iron oxide then acts as oxidizer until it is completely reduced to black magnetic iron oxide, setting free carbonic acid again.

$$FeH_2(CO_3)_2 + Fe_2O_3 + H_2O = Fe_3O_4 + 2H_2CO_3$$

Final product is Fe_3O_4. Reduction does not take place beyond this stage. These iron products are expressed in the equations as oxides although differences of color, red, green, brown and black, coupled with varying stability on standing exposed to air, indicate that they probably exist as hydrates, with the exception of the final black magnetic oxide obtained by hot action.

Nitrate as source of oxygen. After all dissolved oxygen has been used up nitrates are completely reduced to ammonia serving to supply oxygen.

$$HNO_3 + H_2O = NH_3 + O_2$$

Final action of carbonic acid. After all possible sources of oxygen are exhausted, the carbonic acid dissolves more iron, which is probably thrown out of solution finally as insoluble basic carbonate of iron, since after complete reaction there is only about 0.2 to 0.7 p.p.m. iron in solution, no free carbonic acid, no dissolved oxygen, no nitrate, sometimes no bicarbonic acid, and under some conditions caustic lime is present. The alkalinity of hard waters is reduced to about 25 p.p.m.

Sources of dissolving or active carbonic acid. The carbonic acid for the solvent action may be derived from three sources, the free carbonic acid, the bicarbonic acid, and the neutral carbonate. In the latter case the carbonate hydrolyzes so that there are in solution neutral carbonate, lime hydrate, and carbonic acid. This takes place when the water reaches the stage that only neutral carbonate is present. The carbonic acid set free dissolves the iron. The presence of lime hydrate was proven by titration with phenolphtalein and methyl orange.

Source of active carbonic acid affects rate of corrosion. The rapidity of corrosive action is affected by the source of carbonic acid in order as given above, and the amount of soluble iron present during the active stages of corrosion varies with the above order of source of carbonic acid.

Carbonic acid set free by alum. Another source of carbonic acid is that set free in alum treated waters. This is really mostly bicarbonic acid set free. The amount set free per grain of alum per gallon is not as sometimes stated 6.8 p.p.m. but about 3.5 p.p.m. (determined by analysis). This is probably due to the formation of a basic carbonate of aluminum, $AlCO_3(OH)$, rather than the hydrate, $Al(OH)_3$. The compound formed probably varies somewhat with the temperature and may be mixtures of $AlCO_3(OH)$ and $Al_2(CO_3)(OH)_4$. Probably $Al(OH)_3$ forms only upon boiling, as in chemical analysis. The amount of free carbonic acid given, 3.5 p.p.m., agrees with the results obtained at the Little Falls Filter Plant.

It must be understood that the facts as given above apply to new pipe with a *clean iron surface* and to *complete reaction.*

Water as a source of oxygen. Attempts to remove dissolved oxygen from water appear to me to be hopeless as well as expensive, because a consideration of the above reactions brings out a fact that seems to me to have escaped general attention, and that is that 75 per cent. of the oxygen in the iron oxides formed by complete reaction, if all the hydrogen were set free, comes from the water and not from the dissolved oxygen, and the greater part of the hydrogen is set free.

Large amount of iron corroded relative to amount of dissolved oxygen. A very large amount of iron is corroded for each part per million of dissolved oxygen through the catalytic action of carbonic acid and water. For example 10 p.p.m. of dissolved oxygen produces 126 p.p.m. Fe_3O_4, expressed as Fe, whereas if the hydrogen were oxidized and not set free, the amount which 10 p.p.m. oxygen could produce would be only 31 p.p.m. iron. In our experiments 75 per cent. to 80 per cent. of this theoretical amount of iron was produced, the difference from theory being due to oxidation of hydrogen. This is a variable quantity, but about 85 per cent. of the hydrogen oxidized was oxidized during the first fifteen minutes, which substantiates the idea expressed previously that oxidation of hydrogen takes place only at the surface of the iron while dissolved oxygen is present near the iron. The presence of hydrogen gas is easily shown and has been proven by many investigators. Any hydrogen set free means an equivalent amount of oxygen obtained from the water to oxidize the iron.

Effect of kind of iron relative to complete reaction. The experiments were carried out with Byers wrought iron pipe (protected with an inside coat), Reading wrought iron, Black mild steel, and galvanized wrought iron. The first three showed no differences in the corrosive action when carried to completion, but the steel appeared to corrode most rapidly. The galvanized iron showed great resistance at first, but gradually, especially with alkaline water, the action increased somewhat, though in the time of our experiments the highest amount was only about one-third that of the other pipes.

Rate of Corrosion.

Remarkable speed of reaction. Experiments with regard to speed of reaction brought out some surprising facts.

About 50 per cent. of the iron produced by corrosion in the cold is produced in two to three hours. With Croton water (5 p.p.m. free carbonic acid) the action is practically complete in fifteen hours.

Morning rust and new service. This explains the greater tendency in house services, especially in new services, to show rusty water when first drawn in the morning, since the action is complete over night.

Influence of carbonic acid upon rate of corrosion. The rate of corrosion is increased proportionately to the increase in free carbonic acid. The action cold was complete in seven to eight hours with Croton water containing 25 to 50 p.p.m. free carbonic acid. The total iron was also somewhat increased with the higher free carbonic acid.

The carbonic acid hastens the action by dissolving the iron more rapidly. There being more iron in solution, oxidation is hastened. Analyses for soluble iron and dissolved oxygen proved this to be true. The carbonic acid increases the total iron by forming more basic carbonate of iron which is left unoxidized after available oxygen is exhausted.

Alum-treated water showed no appreciably greater corrosive action either in speed or total amount of iron than untreated water. This is due to the comparatively slight increase in free carbonic acid (3.5 p.p.m. per grain of alum per gallon).

Retardation of rate of corrosion by neutralization of carbonic acid. Neutralization of the free carbonic acid by lime hydrate or by sodium carbonate retards the corrosive action.

Neutralization of the free and half-bound carbonic acid by lime hydrate, provided there is no excess caustic, still further retards the corrosive action, and also reduces the total iron produced by cold action 33 per cent. and by hot action 50 per cent.

Neutralization of carbonic acid retards corrosion by reducing the amount of dissolving agent, hence the amount of soluble iron present at any moment and thus slows up the oxidation.

Increased rate of corrosion caused by a slight excess alkali. The slightest excess caustic (a few p.p.m.) up to considerable excess hastens corrosion to almost identically the same degree as does increasing the free carbonic acid to 25 to 50 p.p.m. A large excess of soda ash acts likewise. This action of alkalies has been noted by Cushman and others.

Excess alkali hastens the corrosion by hastening the absorption of oxygen by the iron in solution, though this is smaller in amount at any time. Until the excess of alkali is sufficient to prevent hydrolysis of carbonates the corrosion takes place. Analyses proved that the oxygen is absorbed faster and that only traces of iron are in solution at any time. Compare in this connection the Levy method of determining dissolved oxygen in water, *i.e.*, oxidation of ferrous salts in alkaline condition.

Amount of excess caustic necessary to completely stop corrosion. The excess of alkali necessary to stop corrosion completely is 100 to 125 p.p.m. excess lime hydrate over that needed to neutralize the free and half-bound carbonic acid. Only slightly more is needed to stop corrosion hot than cold. This amount of excess alkali acts by completely preventing solution of iron, for the oxygen still oxidizes the surface of the iron and is completely gone in 24 hours, although no iron over the original amount appears in the water.

The above facts show that whatever helps to put iron into solution is the real cause of red water trouble. It is the iron in the water, dissolved or suspended, which causes trouble, not the iron clinging to the pipe.

Heat hastens rate of corrosion. All corrosive action was hastened by heat (120°–150°F.) so that complete reaction was accomplished in 1½ to 3 hours on the clean iron surface.

Heat hastens corrosion in at least four ways,—by hastening the chemical action of solution of iron, by increasing the amount of free carbonic acid since heat sets free the half-bound carbonic acid of the alkalinity, by creating convection currents that cause the dissolved iron to diffuse more rapidly and hence come in contact with the dissolved oxygen faster, and by hastening the oxidation and precipitation chemically of the dissolved iron.

Action of hard water. The water of the Flatbush Water Company, which has a hardness of about 140 p.p.m., contains only two-thirds as much oxygen as Croton water and 10 p.p.m. free carbonic acid, produced corrosion as rapidly as Croton water on the clean iron surface and a total amount proportional to the oxygen and carbonic acid content as required by theory. Yet in service this water causes no complaint and is generally free from iron and turbidity. This is undoubtedly due to protective scale formed on the pipe, probably consisting of both iron oxide and carbonate of lime. As previously stated the alkalinity of hard waters is reduced to about 25 p.p.m. when the action goes to completion.

Consumption of oxygen as related to speed of corrosion. Dissolved oxygen disappears rapidly in all cases. In the first fifteen minutes 23 per cent. to 37 per cent. were used up due to oxidation of both hydrogen and dissolved iron.

The relative speed of oxidation is best seen in comparing percentages of oxygen used up in 1½ hours.

Temp.	*Croton water*	*Free CO_2*	*Bicarbonic acid*	*Lime hydrate excess*	*Oxygen used up.*
1 hot	untreated	5 p.p.m.	10 p.p.m.	.....	100%
2 cold	modified	0 p.p.m.	0 p.p.m.	27 p.p.m.	87%
3 cold	modified	25 p.p.m.	10 p.p.m.	.....	87%
4 cold	untreated	5 p.p.m.	10 p.p.m.	.....	78%
5 cold	modified	0 p.p.m.	10 p.p.m.	.....	75%
6 cold	modified	0 p.p.m.	0 p.p.m.	.....	68%

It is noticeable that the increases of dissolved oxygen used up in No. 3, No. 4 and No. 5 is approximately proportional to the increases in free carbonic acid in the water.

Relation of oxygen to color and composition of precipitate. So long as there is oxygen in solution the reactions take place rapidly and almost proportional to time and the iron precipitate is red (Fe_2O_3). After exhaustion of the oxygen the reaction becomes slower, the red oxide being reduced to the lower black oxide, turning green to brown to black. The color of the precipitate gives a good indication of the progress of the action.

Relation of oxygen and carbonic acid to soluble iron. While there is dissolved oxygen present there is iron in solution depending upon the amount of active carbonic acid. Soon after the oxygen disappeared it was but rarely that more than 0.5 to 1.0 p.p.m. iron was in solution. The amount of soluble iron present while dissolved oxygen was present was as follows:

Croton water	*Free CO_2*	*Bicarbonic acid*	*Lime hydrate excess*	*Soluble iron*
modified	0 p.p.m.	0 p.p.m.	27 p.p.m.	0.35 p.p.m.
modified	0 p.p.m.	0 p.p.m.	.....	0.76 p.p.m.
modified	0 p.p.m.	10 p.p.m.	.....	3.50 p.p.m.
untreated	5 p.p.m.	10 p.p.m.	.....	5.50 p.p.m.
modified	25 p.p.m.	10 p.p.m.	.....	7.90 p.p.m.

It is obvious that the amount of dissolved iron is greater with increase in the active carbonic acid.

Relation of amount of oxygen to corrosion. The amount of oxygen within wide limits does not seem to affect the *rate of corrosion* materially, but the total amount of iron removed from the pipes in complete reaction, other factors remaining the same, is directly proportional to the dissolved oxygen in the water.

Protective Coatings.

When iron pipe is exposed to the continuous action of water, as in service, a protective coating forms according to the nature of the water.

Coating delays corrosion. Its action is to delay corrosion rather than to stop it and to reduce the amount of iron appearing in the water. The corrosion goes on slowly but the oxides cling to the iron increasing the amount of scale.

Protective character of coating varies with the water producing it. In cold action the greatest protection was acquired experimentally in ten days and then remained constant. Flatbush and Brooklyn waters caused a better protective coating than Croton water. The iron produced in 24 hours dropped from 114 and 85 p.p.m. respectively for the two former to 21 p.p.m. Fe., for the Croton and its modifications from 56–102 to 29–36 p.p.m. Fe. Croton was tried in four modifications,—untreated, with free carbonic acid neutralized by sodium carbonate, with free carbonic acid neutralized by lime hydrate to bicarbonate, and treated with one grain per gallon of alum.

In hot action the protective coating formed in two days. Flatbush water reached the lowest level of 3 p.p.m. iron with an average of 8. Brooklyn water reached 4 p.p.m. iron with an average of 9. Untreated Croton fluctuated high and low with an average of 41 p.p.m. iron. The alum treated Croton averaged 26. The soda neutralized Croton averaged 15 with a minimum of 11, and the lime neutralized Croton averaged 23 p.p.m. Fe. All the averages, cold and hot, include results from the tenth to the twenty-first day.

Action of carbonic acid upon pipes with coatings. The pipes which had acquired a protective coating from these different waters were subjected for 24 hours to the action of untreated Croton water and to Croton water containing 20–27 p.p.m. free carbonic acid.

The water with increased carbonic acid produced an average of 38 p.p.m. iron from the pipes with scale formed in cold action against 24 p.p.m. produced by untreated Croton (5 p.p.m. CO_2). On the pipes with scale produced in hot action about the same relative quantities were produced, 34 against 22 p.p.m. Fe., showing that water containing the greater amount of carbonic acid causes more corrosion upon pipes protected by scale.

The scale produced by Flatbush, Brooklyn, and soda neutralized Croton water proved the more protective.

GENERAL SUMMARY.

Extensive corrosion takes place rapidly in new pipe while the iron is fairly clean from incrustation. This explains the abundance of complaints of iron rust in new service installation.

Concerning the kind of pipe there is little doubt that steel pipe is most readily attacked, wrought iron next, and galvanized iron the least. The latter is far preferable for use. Lead pipe should never be used any more than absolutely necessary because of the danger of accumulative poisoning with minute amounts of lead (less than 0.5 p.p.m.).

The chief agent in dissolving the iron is carbonic acid, as it is also the chief agent in holding iron in solution.

The chief agent in carrying the rusting to the greatest extent is oxygen.

Through the catalytic action of active carbonic acid, about 70 per cent. of the oxygen in the iron rust comes from the water by chemical decomposition, hydrogen gas being set free. The remainder only, about 30 per cent., is furnished by the dissolved oxygen in the water.

Waters which give the most trouble are very soft and contain considerable free carbonic acid.

Hard waters rarely cause complaint as they form an excellent protective coating on the pipes.

The action in distribution services probably never reaches completion on account of protecting scale of oxide, etc., which retards corrosive action. The scale varies with different waters in protective properties. Tap samples in New York City have shown no appreciable diminution in dissolved oxygen or in free carbonic acid, so that only slight corrosion can have taken place in proportion to volume of water and possible reaction. Even hot services have shown the usual amount of carbonic acid and more oxygen than would saturate the water at the temperature when drawn.

Since in distribution services there is no exhaustion of oxygen, any increase in free carbonic acid may mean a possible increase of soluble iron in the water, which would be precipitated in the hot water supply.

Neutralization of free and half-bound carbonic acid is impracticable as it tends to hasten corrosion if there be the slightest excess of hydrate, removes zinc when hot from galvanized pipe, interferes with alum precipitation and color removal, and produces considerable precipitation of calcium carbonate in the water, which would deposit in the pipe system, meters, etc., unless previously removed by filtration or sedimentation.

Neutralization of only free carbonic acid is feasible, since it retards corrosion and reduces the amount of soluble iron.

Either soda ash or lime oxide may be used. Both reduce the corrosive action, cold or hot. Only sufficient lime should be used to form bicarbonate. This reagent increases the hardness 1.1 p.p.m. for every 1 p.p.m. free carbonic acid neutralized to bicarbonate. About 5.3 pounds CaO per million gallons of water are required for each 1 p.p.m. carbonic acid. It is best handled dry. It costs about two cents per million gallons per 1 p.p.m. carbonic acid.

Soda ash is more soluble, can be handled in concentrated solution and consequently in small sized tanks, and probably with better regulation of dosage, would not increase the hardness, but on the contrary would decrease the lime sulphate in the water, changing it to sodium sulphate, thus improving the water for boiler use and for other industrial purposes. It also apparently helps to form a better protective coating on the pipe. About 20.2 pounds soda ash per million gallons of water are required for each 1 p.p.m. carbonic acid. This would cost about 20 cents per million gallons for each 1 p.p.m. carbonic acid. Soda ash has been used successfully on a small scale to obviate red water trouble. The great difference in cost is due to greater molecular weight, less combining power, and greater cost per pound. The cost must be considered in connection with the degree and advantage of the change of sulphates to carbonates, etc.

Aeration of water by splashing followed by neutralization of residual free carbonic acid (about 5 p.p.m.) is probably the best practice.

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PREVENTION OF IRON CORROSION.

W. F. Montfort.

In his original paper in 1903, Whitney (1) laid the foundations of the electrolytic theory of corrosion of iron and stated the rationelle of rust prevention by reducing the concentration of hydrogen ions in pure water, or the introduction of some substance which should increase the concentration of hydroxyl ions.

Prior to this publication Adams (2) in 1900 had shown that the addition of 56 grains of sodium carbonate, or 43 grains of ammonia (NH_3), or 5 grains of sodium oxide per gallon were required to wholly prevent the rusting of iron on water.

Still earlier Fuller, in reports on experiments in purification of Ohio River water at Louisville and at Cincinnati, published in 1899, suggested that the increased corrosive character of water coagulated with sulphate of aluminum might be corrected by addition of lime.

The practical application of lime for prevention of corrosion in cases of localized "red water" seems to have antedated Whitney's paper, since experimental work on removal of carbon dioxide and iron from water mains as a preventive of the development of crenothrix by treatment with lime had been carried on before 1903. In a communication to an engineering journal Milligan (3) refers to lime treatment for crenothrix at Freeport, Ill., described in detail by E. C. Smith (4) and O. T. Smith (5) and mentions further sundry other occurrences of "red water" which had been successfully obviated by application of lime. Dates and details of these applications in New England, New York City and Philadelphia are not given.

In England the addition of chalk in treatment of very soft waters has been practised for many years. If added in a quantity slightly in excess of that required to unite with carbon dioxide as bicarbonate the normal carbonate dissolves, giving hydroxyl ions.

Theoretically and practically this addition of hydroxyl ions, whether from lime or from hydrolyzed calcium carbonate, results in a more or less complete inhibition of corrosion, when dissolved carbonic acid is the sole agent increasing the concentration of hydrogen ions.

In the later discussions of red water in a staff article in *Engineering Record* (6), by Weston (7), Ledoux (8), and Fuller (9) frequent reference is made to this occurrence in specific waters more or less impregnated with organic matter. Unfortunately color determinations are not always recorded. And while the elusive nature of these obscure compounds makes difficult the discussion of their bearing upon the question of corrosion, the importance of these factors may not be disregarded.

An interesting discussion of the experimental use of lime and of soda ash upon various waters in iron pipes after seven days' contact for cold waters at 50 to 70° F. and three days' for hot water at 125 to 135° F., by Clark and Gage (10), is summed up as follows:

"The investigation is not yet finished, but it is evident that those so far made have given results that are in accord with observations in various parts of the country: namely, that when soft waters are purified by coagulants and mechanical filters, they have a greater corrosive action upon iron than before purification and greater than the same supply when filtered through sand, and that increasing the hardness of mechanically filtered water to a reasonable degree has little effect upon corrosion."

These were supplies of high and of moderate color. The specific nature of the organic matter is not stated, nor is the color recorded in the report. Data are wanting as to the amount of lime or soda ash added, and the presence of hydroxyl ions in the samples tested is not affirmed.

Ledoux states (8) that the swampy water of Charleston (S. C.) supply is highly corrosive before filtration; the removal of most of the organic matter by treatment with sulphate of alumina and filtration reduces the corrosive effect to a minimum. The color may not be entirely removed without the addition of an excess of aluminum sulphate sufficient to cause corrosion, which can, however, be eliminated by the application of lime, at a sacrifice of color reduction. As pointed out by Mr. Weston (7) there is no statement of the experimental addition of lime after successful color elimination and filtration. Nor is there a statement of

the relative alkalinity toward phenolphtalein and erythrosin to suggest the presence of more or less hydroxyl. There is a possibility that the corrosive character of this water was principally due to dissolved carbon dioxide, and that the presence of hydroxyl ions was all that the filtered water demanded to insure against corrosion.

Some interesting observations of protective organic matter are given by Mr. Weston and confirmed by Messrs. Clark and Gage, which suggest that the reduction in quantity or change in the quality of organic matter by filtration may induce corrosion.

Mr. Weston (7) cites the case of lead service pipes at Concord, Mass., under observation for ten years, where no more corrosion appeared in 1910 than in 1900, and that of Exeter, N. H., which had been for four years supplied with filtered water, always alkaline and free from sulphate of alumina, where there had been some complaints recently (1910) of "red water" in hot-water systems. This he considers may be due in part, as at Springfield, to the poor quality of pipes and tanks, referred to by Mr. Whipple (11), but Mr. Weston ascribes it in great part to the removal of organic matter by filtration. "The effect of filtering such water is like changing from a colored surface to a clear ground-water supply. This change has been known to increase corrosion. Slow sand filters might effect an equal or greater increase in the amount of carbonic acid, but because the removal of organic matter would not be so complete, it is probable that there would be more protection afforded by organic matter collecting on the insides of the pipes. In the writer's opinion most of the increased corrosion of pipes ascribed to filtered water is due to the withdrawal of organic matter which would form a protective coating."

This acceleration of corrosion follows not only coagulation and mechanical filtration, where the effect might be attributed to the increase in carbon dioxide and the greater conductivity of water treated with a coagulant; the effect is noted, though in less degree, after filtration through sand, without coagulant. The organic matter which is protective for any reason is most readily removed by filtration; the residual matter, whether originally different in character, is different in its behavior when left alone. There is room for discrimination in the varieties of organic matter in colored waters, before the whole question of corrosion can be understood.

The discrimination which is made in regard to the behavior of colored waters during coagulation is suggestive. It is a matter of common experience among operators where coagulation of colored waters is practised, that generally a certain proportion of the coloring matter is removed with ease; that when color is higher a proportionate increase in the charge of alum is not followed by corresponding effectiveness; that in some cases of moderately high color addition of alum gives no visible floc though the alkalinity present is sufficient to react with the full dose of alum used.

Oxidation of freshly prepared leaf extract by potassium permanganate is difficult, although readily carried to completion after some months of standing. The determination of oxygen consumed in colored waters from the Upper Mississippi drainage area is sometimes very slow, requiring unusually prolonged digestion for complete color reduction. There seems to be a residue of organic matter not readily attacked by oxidizing agents until after months of exposure to air and light at ordinary temperatures.

It has occurred where iron sulphate and lime were used in treatment of such a water, having a color of 90, with the addition of lime to produce a caustic reaction (alkalinity toward phenolphtalein, 62, total, 116), a color of 35 parts per million persisted, and 2 to 3 parts per million of iron remained in solution. When this water was heated to about 150° F. in hot-water pipes there was developed the red color of ferric hydroxide. In this case the precipitation of iron by an excess of hydroxyl was incomplete at ordinary temperatures, and only prolonged digestion with dissolved air served to remove it from solution.

The failure of alum to give a precipitate with abundant alkalinity, and of ferrous sulphate in the presence of hydroxyl ions, suggests the formation of complexes like those little ionizable alcoholates with metal ions, formed by citrates, tartrates, sugars, and the like, which necessitate special procedure in analytical determination of iron and aluminum.

Glucosides freshly derived from vegetables tissues (13) would suggest themselves as the

possible agency in this retarding action, while their decomposition products might assist in furnishing the protective matter which accumulates with organisms in the slimy coating of old pipes as well as on sand grains of filters.

It would be interesting to have experimental results on precipitation of iron ions with increasing hydroxyl concentrations in some of the most studied "red water plague" spots, to ascertain whether there is not some organic matter present which acts in a similar manner, holding in cold solution considerable quantities of iron, which are released on digestion with dissolved oxygen under conditions like those in hot-water pipes.

It may be that the development of some method of speedily ripening coloring matter for immediate removal is prerequisite to the theoretically easy prevention of corrosion proposed by Whitney. In cases where this ripening has already been accomplished, as in the instance cited by Mr. Ledoux (8), the prevention of red water appears simple, though accomplished at a considerable increase in hardness. In other instances, it may appear that aëration for partial removal of carbon dioxide will sufficiently prepare a water for color removal and the inhibition of corrosive action. There are doubtless others which will be better met with another treatment.

The removal of color from a relatively hard water, containing much magnesium, is well accomplished to the extent that magnesium carbonate is precipitated. It is at an early stage in the progressive addition of lime water that the greatest color removal occurs. Addition of magnesium chloride or sulphate and precipitation from soft colored waters of large volumes of magnesium hydroxide is not productive of the same degree of color reduction. The success of the magnesite used by the Candy Filter Company in English practice suggests the propriety of appeal to this reagent as better adapted for the removal of color from very soft waters. The question of the occurrence of magnesium carbonate in chalk so commonly used in treatment of soft English waters may be fairly raised, as a possible explanation of the success of chalk treatment and the general failure of the use of lime alluded to by Mr. Thresh in his discussion of Mr. Whipple's latest paper (12).

SUMMARY.

The purpose of this paper is to emphasize the intimate relation between certain forms of organic matter, and the varied behavior of coloring matters in natural waters, which have served to protect or to increase the corrosion of metals in water.

Corrosion in many cases is associated with highly colored waters.

Some apparently conflicting evidence is cited as to the effect of lime treatment on colored waters.

Organic matter may be either protective or corrosive.

A discrimination is made in the behavior of organic (coloring) matter with coagulants, and a suggestion offered as to the possible cause of some cases of red water in hot-water systems, from the breaking down of complex alcoholates with metal ions.

The question is raised as to the development of color removal methods as prerequisite to a full understanding of some local occurrences.

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PROGRESS REPORT OF THE COMMITTEE ON COLLECTION AND DISPOSAL OF SEWAGE.

Read before the Sanitary Engineering Section, American Public Health Association, Colorado Springs, September, 1913.

Introduction.

It was the intention of the Council, as set forth in the letter of the secretary notifying members of their appointment, that this committee should review the field of sewage collection and disposal, and select certain topics which might profitably be made the subject of discussion at this meeting or delegated to special committees for future investigation.

As an inducement to such discussion, it is proposed to briefly outline those phases of sewage collection and disposal which are most closely related to sanitation, touching the construction side of the work only incidentally.

The statements made should be considered in a broad, general way and not as applying to every individual case, for frequently local conditions make special requirements necessary.

The Collection of Sewage.

Sewage collection in the present day sense may be taken to mean the removal of domestic and manufacturing wastes by water carriage in a system of underground conduits, which, through the house connection, laterals, main and intercepting sewers, serves to convey these wastes from the dwelling to the point of discharge or treatment.

Towns not having a sewer system usually depend upon the pail system, privy vaults or cesspools for the collection of the excreta of the citizens, The danger of the contamination of water-wells and of the spread of fly-borne diseases from these methods renders them a menace to the public health.

Sewerage systems are the outcome of modern water supplies. So long as people live scattered over the country, no difficulty is found in disposing of the offensive refuse of living. Under such conditions the amount of water consumed is relatively small, and the simple natural agencies of absorption and diffusion serve to dispose of it when made dirty by use. With concentration of population, however, the pollution of the individual sources necessitates a public supply. The greater convenience of the faucet over the pump soon results in bringing into the populated area a greatly increased amount of water, for the discharge of which artificial provision must sooner or later be made. If the soil is impervious and of low capacity for absorption, conditions soon develop which suggest the

use of pipes to carry the sewage away. Generally some drains have already been built to discharge surface water; with these the premises are connected, and the offensive wastes are emptied into the nearest water-course. If this water-course is too small to properly dilute the sewage, a local nuisance follows; this, and the fact that other citizens have not been so fortunate as to find an outlet for their liquid refuse brings to a focus the problem of constructing a sewerage system. At the present day, this generally occurs before conditions have become so bad as to greatly affect the health of the community.

Separate and Combined Systems. A modern system of sewers has two functions: first, to remove rain-water from the streets, yards and roofs of the town; second, to remove the liquid wastes of the community and convey them either to water-courses or to treatment works.

In order to accomplish these dual functions two types of construction have been adopted, known as "combined system" and "separate system."

The combined system originated in the drains which were built in early times with the intention of carrying rain-water exclusively and lowering the level of the ground-water. Into these drains the sewage of the town was admitted. In this system, therefore, the sewage and rain-water are carried in the same conduit.

In the separate system the sewage and rain-water are carried in separate channels. The rain-water is discharged directly into nearby water-courses and the sewage is carried to a point where its discharge will be less objectionable or to a treatment works.

Intercepting Sewers: Where a city is already sewered upon the combined system and where the discharge of the sewage into a natural water-course either creates a nuisance or is prejudicial to public health, it becomes necessary to treat the sewage before its discharge. In such cases an intercepting sewer may be built parallel to the water-course with suitable connections to the collecting sewers, so that the dry weather flow of sewage and first flush of the rain-storm flow into the intercepting sewer. During times of storm the excess rain-water and the very much diluted sewage overflow into the water-course; for the expense of treating all rain-water would be prohibitive. In England the requirements of the authorities stipulate that the storm-water overflow shall only come into operation when the flow of sewage is increased sixfold and the sewage works must be constructed to deal with six times the normal dry-weather flow. Since the consumption of water in England is approximately forty gallons per capita per day, and the consumption in America sometimes exceeds 200 gallons per capita per day, it is evident that the dry-weather flow of sewage in America is nearly five times as dilute as that of English cities. Arrangements, therefore, for intercepting the dry-weather flow of sewage and the first flush of a rainfall compare well with English practice.

Velocity of Flow. Obviously, since the object of the collecting system is the rapid and complete removal of the decomposing wastes by water carriage, the provision of such hydraulic conditions as will best effect this result is an important consideration in the design. The gradients of all sewers should be such as to develop self-cleansing velocities, which the best practice shows should not be less than two feet per second in the separate system and two and one-half feet per second in the combined system. Steep gradients, however, necessitate deeper trenches, and here, as in most engineering problems, a solution must frequently be found between the ideal and that economically possible. As a result, flatter gradients than will give the above-named velocities are often used, and while more frequent flushing is made necessary, no trouble has resulted, provided the sewers are constructed with due care to obtaining a smooth interior surface. Where the expense of obtaining steeper gradients is material, an actual velocity of one foot per second in a well constructed sewer, carrying domestic sewage, will, with a reasonable amount of flushing, keep the sewer clean. Trade wastes of certain character, however, require higher velocities to prevent deposits.

Ventilation. Ventilation of the system becomes a problem where the sewers are not kept clean by the normal flow, or by flushing. Unless deposits form and decomposition results, there is little odor from sewage, and the danger of disease transmission by sewer gas is negligible. The omission of the house trap and the use of the main riser through the house to a point above the roof is the most effective means of inducing circulation of the air in the sewers, and, with proper inspection of the plumbing system, involves no danger, but the best solution of the problem of ventilation is, as already stated, to maintain clean sewers.

Trade Wastes. Sewer systems are primarily designed and built to carry domestic sewage and rain-water. The introduction of trade wastes having certain characteristics is, therefore, liable to injure the sewers in the following ways:

(a) Heavy mineral solids, such as lime from glue works, dust from marble yards, etc., can form deposits in the sewers which retard the flow and reduce the carrying capacity.

(b) Gelatinous materials, hair from tanneries, grease from wool works, and similar substances, by adhering to the perimeter, increase the roughness of the interior surface and so reduce the carrying capacity.

(c) Acid wastes injure the cement joints between brick work or pipes, or attack concrete, causing leakage and destruction of the fabric of the sewer.

(d) Liquids of high temperature may soften and injure the bituminous joints in pipe sewers used to prevent the infiltration of ground-water.

(e) The discharge of live steam, volatile liquids or inflammable gases;

or the sudden emptying of vats of hot water, cause a serious menace to men working in the sewers.

Trade wastes having the above properties should be strictly excluded from the sewer system, unless submitted to sufficient treatment to remove the objectionable characteristics—as, for instance, the wash-water from garages contains gasoline, which can be easily removed by passage through an intercepting tank, as required in London.

In regard to the admission of other trade wastes it may be said that it is cheaper to dispose of manufacturing wastes in combination with the sewage than separately, and sometimes purification is only made possible by admixture with the sewage. Generally, it is good civic policy to aid manufacturing interests by providing an outlet for the liquid wastes, but obviously, since there is no greater obligation on the part of the community to take care of liquid than of solid manufacturing refuse, the power should be given those in authority to levy special assessments, based on some logical expression of the increased cost of maintaining the sewerage systems caused by the entrance of these wastes. Further, it is evident that in many cases preliminary treatment of the manufacturing wastes must be required, and none should be admitted which will injure the sewer, increase the cost of maintenance beyond that involved in independent disposal, or prejudicially affect the treatment of sewage.

Ground-Water. The reduction of the leakage of ground-water into sewers, where treatment of the sewage is required, is a feature which is of sanitary interest. Many disposal plants are overworked, and overflows into the neighboring water-courses made necessary because of leakage in the seasons when the ground-water is high. It is believed that the expenditure of the money necessary to secure tight joints is well justified and should be given careful consideration.

In connection with the reduction of leakage, it is good practice to lay underdrains beneath the sewers, lowering the water-table, and, by improvement of subsoil conditions, subserve the interest of public health.

Finance. While not strictly within the scope of this discussion, a few words in regard to the financing of a sewer system may not be out of place. Very frequently the sanitary necessity for improved sewerage is confined to a limited section of the town or city. Those living outside of this more congested section are satisfied with their present method of individual disposal, and oppose the undertaking of a municipal system. The result is that very often the work is thus delayed because of a feeling that the entire community will have to pay for something from which only a part will obtain commensurate benefit. The answer lies in a proper method of assessment, which will require contributions in proportion to the benefits conferred. Thus, if a small part of the total expense is met by a general levy on all property to express the sanitary betterment to

the entire community, a larger part is raised by assessment on property abutting on streets where sewers are built, whether those sewers are used or not, and, a still larger part is obtained by rentals for actual use, the relative benefits will be fairly indicated, and the opposition to the improvement by those not particularly in need of sewers may be thus removed.

Comprehensive Planning. Good design and adequate supervision of the work in construction are necessary to success. Because laying a pipe in trench appears easy, too often insufficient care is taken in construction. The essential requirements for a clean, sanitary sewer, are true gradients, straight lines, and a smooth interior which will facilitate the water carriage of the solid matter; and to fulfil these requirements careful supervision is necessary. In many cities sewers have been built in piecemeal fashion, not following any general plan, and with small regard for future conditions. The result is subsequent difficulty in the design of interceptors when treatment becomes necessary. It is good civic policy to have a comprehensive design prepared which can be followed, as the sewers are from time to time constructed. Our towns and cities are rapidly growing, so that the population contributing sewage may overtax streams now adequate to care for it. It is, therefore, wise to provide for treatment works which can be added when needed. In other words, if a complete sewerage system is designed in the beginning each increment can be added and fully utilize the existing structures. It should also be borne in mind that the addition of sewage of a town from a number of sewer outlets is less liable to overtax the diluting power of that stream than when the intercepting sewer has collected all the town's sewage and discharges it at one point.

The Disposal of Sewage.

The disposal of sewage is complicated by many perplexing phases. Twenty years ago scarcely anything was being done in this country in the line of treating sewage, not so much because there were no nuisances caused by sewage pollution of running waters, but because ways of obviating them were undeveloped. Since that time various methods have been satisfactorily demonstrated, so that today both domestic sewage and trade wastes may be purified to any desired degree, if financial means be provided. The main question is, to what degree shall sewage be treated to meet in a satisfactory manner a wide range of conditions.

Sand Filters Set the Standard. The classic investigations carried on by the Massachusetts Board of Health during the past twenty-five years and the practical experience derived from the treatment of sewage in New England towns (such treatment being confined for the most part to filtration through intermittent natural sand filters with resulting high degree of purification), doubtless tended in the beginning to instill into

the minds of sanitarians the belief that it was desirable and perhaps necessary to purify sewage very thoroughly in all cases where treatment was required before discharging it into running waters. Thus the early standards of purification set by New England practice were very high.

The Coarse Grain Filters. West of and beyond the glacial region, broad areas of sandy soil were seldom available. The cost of procuring sand and fine gravel and transporting it from a distance was prohibitive. Intermittent sand filters were thus eliminated from choice, excepting on small installations. Consequently, coarse-grained, less efficient filters have gradually come into use. Supplemented by chemical disinfection a non-putrescent, nearly sterile effluent can be obtained from these, even though it may not always be clear.

Need for Economy. Viewing the problem broadly, it is a fact that to purify sewage to a degree which will render it innocuous to health will entail an expense which is not commensurate with the benefits to be derived therefrom. The tax rate in American cities is rapidly increasing, owing to rapid growth and the demands of modern civilization. Municipal funds may be used to greater advantage and benefit in other ways than attempting to purify sewage to the complete elimination of its potentially dangerous qualities.

Surface Waters Polluted. Surface waters flowing through territory inhabited by man is almost certain to become polluted by agricultural drainage, street washings, and other refuse of man's activity, including sewage. Even in the case of towns provided with a complete sewerage system and the most thorough means of treatment of its sewage, there are storm-water overflows which discharge at times street waste and even sewage in a crude state into the water-courses; the majority of sewage treatment works have emergency overflows, or by-passes, which may allow partially treated sewage to enter the stream in the event of the disarrangement of any part of the system.

These are only a few of the reasons why surface waters require purification before being delivered to the consumer, whether or not there is a complete system of sewage treatment caring for all towns along the stream.

Recognizing the basic fact that surface waters are bound to be polluted, and recognizing the futility of attempting in general to render the sewage innocuous to health (that is, to destroy all the pathogenic germs it may at any time contain), it then becomes necessary to determine to what degree sewage must be treated.

The Degree of Treatment Required.

To determine the degree of treatment required for sewage in any particular case requires consideration of the whole water-shed of the

stream. On a large drainage area there are usually a number of communities which have a unity of interests. It is not always possible to prescribe the exact degree of cleanliness which should be maintained in the water-course, because it will differ with each stream and at different points along the same stream. As, for example, in the case of two communities, one near the head-waters of the stream and having several communities below it, the other near the mouth of the stream, which may be a tidal estuary.

The degree of treatment required in each case will depend on the amount of pollution permissible in the light of the use to be made of the water of the stream below the point of discharge of the effluent.

These are cases where it is, doubtless, expedient and wise to purify sewage to a greater degree than in others, as, for instance, where numerous cities and towns are located within a relatively close distance of one another and each taking its water supply from and discharging its sewage into the same river.

Other things being equal, it is always easier to satisfactorily purify and render safe a polluted water the less polluted that water is.

Logical reasoning forces the conclusion that all waterways are necessarily polluted, and where such waters are used as a source of water supply that they should be purified before consumption. Basically, the broad problem may be stated as follows:

1. Sewage, or effluent from treatment works, must continue to be discharged in increasing quantities into running waterways and tidal estuaries.

2. The establishment and maintenance of conditions offensive to the æsthetic senses through discharge of sewage must be guarded against.

3. Where sewage is treated so that upon its discharge into the rivers and tidal estuaries no offensive conditions are set up as regards objectionable appearance and odors, and no undue load is placed upon the water filters within the influence of the sewage discharged, and where a suitable margin of safety is allowed, the problem of sewage disposal, broadly speaking, has been solved.

With few exceptions, all sewage should receive some form of treatment in order that offenses shall not result. These refer, first, to overtaxing the digesting or oxidizing power of the diluting stream; second, to the formation of sludge deposits on the bed and banks of the stream, these deposits putrefying later, and setting up and maintaining offensive conditions; and, third, the presence of floating material and oily sleek.

Omitting from the problem of sewage disposal the influence on water supplies, it may be said that, with sufficient dilution and adequate velocities, screening to remove floating matter is the minimum degree of treatment required in any case. Usually, however, it is necessary to go further and remove the heavy suspended matter leaving only that which is light

enough not to deposit in the stream and if the flow of the stream is sufficient to dilute the clarified sewage and prevent offense, the problem is solved. It is not permissible to allow such highly objectionable conditions as are found in the Blackstone River in Massachusetts, the Passaic River in New Jersey, and in Bubbly Creek, a tributary of the Chicago River in Illinois. The Mississippi River receives the sewage of some 10,000,000 people, yet the dilution is sufficiently great to preclude for many years the establishment and maintenance of offensive conditions anywhere along its route. Local nuisances at outfalls might, however, occur. The reasonable solution would appear to be a study of each problem in the light of minimum stream flows and volume of sewage, and under summer conditions. The character and extent of treatment of the sewage should then be adequate to meet these extreme conditions. There is a sanitary aspect of the problem, as well as an æsthetic aspect. A river, otherwise not offensive, can be so charged with sewage as to preclude the use of its waters as a desirable source of domestic supply. There must, in line with good public policy, be a limit, from the health standpoint, to the pollution of drinking-water with sewage.

In the filtration of such polluted river water, under most trying conditions, experience has demonstrated the desirability of adding hypochlorite of lime or other sterilizing agents. The temporary admission of raw water to the town during shut-downs of the water filtration plant, through accident or other cause, has in not a few instances resulted in epidemics of water-borne diseases.

Even though filtration be used the source of water supplies should not be so polluted but that in cases of emergency, the raw water cannot be sterilized and delivered safely into the mains. This points to the proposition that to preserve the public health it is not only necessary to purify the water supply but also to protect its source. It is feasible, for short periods, to render river water that is slightly contaminated, pure and wholesome for domestic use through the application of a chemical germicide; but such mode is not sufficient where the water is very much polluted with sewage. Existing statutory laws of the several states differ. Constitutional provisions necessarily control to some extent. Uniformity of laws will not be approached until there is some Federal authority, like a national board of health, whose duty, among other things, it shall be to exercise proper control over interstate stream pollution.

Fish Industry. The fish industry is not usually affected in moderately polluted waters, unless certain trade wastes are present to taint the flesh with tastes, or poison the fish. The amount of pollution must be carefully studied, as well as the minimum oxygen content, to determine whether the environment it favorable. Fish are usually eaten after thorough cooking.

Shell-Fish. With shell-fish, which in numerous instances are consumed uncooked, it is different; inasmuch, as it is not feasible to render sewage innocuous by itself, dangerous bacterial contamination of shell-fish grown in grossly polluted waters, cannot be prevented. And generally the value of shell-fish industries is of far less importance than the comfort and convenience of cities and towns which are forced by circumstances beyond their control to use running water for the disposal of their sewage.

The conservation of the shell-fish industry in polluted waters may be aided by the sterilization of sewage before discharge therein, but shell-fish should not be harvested or marketed from water exposed to sewage pollution except in such localities where properly instituted technical authorities shall determine the origin of pollution to be sufficiently remote from the shell-fish beds to avoid contamination.

Trade Wastes. The trade waste phase of sewage disposal is perhaps more difficult of satisfactory solution than the main sewage problem, for the following reasons:

Trade wastes come from industrial development which constitutes the financial backbone of the country's welfare.

If the industries are compelled by certain local conditions to purify their wastes before discharge to a greater degree and at a higher cost than their competitors, more favorably situated, where competition is sharp, their business profits may be seriously affected and even result in their financial ruin.

Generally speaking, the presence of trade waste, in the proportion usually found in normal city sewage, does not affect the efficiency of sewage treatment.

Where, however, large industries add certain wastes to a sewerage system, the treatment works of which were designed for purely domestic sewage, it is possible that the works may be totally unable to successfully treat the mixture.

Industrial wastes are frequently discharged from tanks in large volumes during a short time. This places an unnecessary burden upon the treatment works and can be prevented by the discharge of such tanks at a slow rate.

There are trade wastes which, under certain local conditions, affect the efficiency of water purification works, adding to the expense of their operation and even seriously affecting their hygienic efficiency. When such injurious conditions are caused by trade wastes, two solutions appear possible:

1. For the producer or manufacturer to so treat the waste before its discharge that the obnoxious conditions are removed.

2. For the producer or manufacturer to reimburse the affected parties for the additional cost of treatment caused by the trade waste.

Night-Soil. In the water carriage collection of sewage the water-courses have received and must always continue to care for the liquid portion of the sewage. When, however, a town is not so equipped and the excreta of the citizens is collected by pails, privy vaults or cesspools, the problem of disposal is different. The material so collected is called night-soil and its sanitary disposal has been much neglected in the past.

One of the common modes of disposal is the storage of the night-soil in poudrette pits and its later use in liquid form as fertilizer for garden vegetables. While pathogenic bacteria are not thought to increase under these conditions it is known that they maintain their viability for considerable periods of time, and such a use for night-soil cannot be too strongly condemned.

The sewer system is rapidly replacing this unsanitary method of collecting excreta and the quantity of night-soil to be disposed of is steadily decreasing. Permanent and expensive methods, such as incineration or drying by heat are, therefore, rarely practi-ed except in field service or construction camps. Where all conditions are favorable a solution can be found in establishing a station in some isolated section where the night-soil can be brought, flushed by water through screens to restrain rubbish, a disinfectant added, and the diluted liquid admitted to a trunk sewer where, mingling with the large volume of sewage, it will either reach a water-course or treatment works.

The Treatment of Sewage.

The general sanitary principles governing the disposal of sewage upon hygienic and æsthetic bases having been determined upon, the treatment of sewage in order to maintain these conditions in the water-courses is largely an engineering problem, and, therefore, the basic principles only are given herein.

Nature has provided for the conversion of all dead waste into food for living organisms through the biological forces of the soil and water-courses. It is only when man overtaxes these natural resources that ill results follow. In order to avoid this overtaxing, man has been forced to construct artificial works to assist nature, in the design of which it is the duty of the engineer to utilize every natural resource to the fullest extent in the interest of economy, so long as it is compatible with the protection of public health.

Discharge of Crude Sewage. There are cities situated upon large bodies of water not used for water supplies, and having sufficiently high velocities of flow to prevent deposits of sludge; where crude sewage is discharged after coarse screening in a way to be thoroughly diffused with water and does not violate the hygienic or æsthetic standards proposed above.

Removal of Suspended Matter. The minimum amount of treatment usually consists in the removal of the coarser suspended matter and the

heavy mineral detritus. The use of coarse screens will prevent the offensive appearance of a water-course caused by floating solids of sewage origin, and the silting up of the point of discharge is prevented by the retention of the detritus in grit chambers.

Where the diluting power of the stream is not sufficient, or where velocities of flow are such that deposits would form, which, by decomposition and putrefaction deplete the water of its natural oxydizing powers, more suspended matter must be removed from the sewage. This can be accomplished by the use of either fine screens or sedimentation tanks. If the settling solids are removed by tanks the deposits of sludge in the water course are prevented. The biological forces of the water-course, therefore, are only required to care for the finely divided and soluble organic matter of the sewage effluent.

While dilution may care for the liquid effluent after sedimentation, the sludge removed from the fine screens, or from the tanks, must be handled in a sanitary manner. Screening stations usually are accessible to power or garbage disposal plants where the screenings can be burnt.

In Germany, and in this country, it has been shown that the separation of the settling sewage and the decomposing sludge in two-story tanks will keep the sewage, during its retention, nearly as fresh as received. If the sewage be stale and odorous, however, this type of tank has no deodorizing effect, as its only function is the removal of suspended matter and decomposition of sludge.

The sludge withdrawn thereform is practically odorless, drying quickly, and is suitable for filling low land or lightening heavy soil for agricultural purposes.

Removal of the Putrescence of Sewage. Where sewage must pass into water-courses of limited volume, or where for sanitary reasons, it is necessary to still further treat the sewage, the removal of the settling suspended matter is supplemented by biological treatment in prepared beds.

The sewage should preferably be freed of its settleable solids before such treatment in order to secure higher rates of operation.

The intermittent filtration of sewage on sand beds accomplishes complete treatment; inasmuch as the suspended matter in the crude sewage applied is collected at the surface, the organic matter is almost completely oxidized in the pores of the filters and the bacteria largely removed by the smutzdecke. The rate of filtration is necessarily low.

In bacteria beds or the rapid coarse grain filters, however, the action is much less complete, since it only converts the putrescible material into fairly stable forms, so that when such an effluent is discharged into the water-course the purification begun in the artificial works should continue.

Design and Operation of Sewerage Works.

It has already been stated that expert services are required for the efficient design of a sewer system and treatment works. Equal necessity exists for the skilled supervision of the operation of these works, the extent to which such supervision should prevail depending upon the type or class of works.

It is possible to determine along general lines what the proper attention for each class of plant should embrace.

It follows that skilled supervision of the operation of sewage works must be compulsory.

State or Federal control is indispensable, although supplementary in character.

The foundation for efficient and economical operation of sewage treatment works generally must be based upon careful statistics of operation.

Records of daily operation of works should be uniform for the same class or type of plant and to enforce such records requires the exercise of not only local but also of state and national police power.

The management of works is so well expressed by Mr. John D. Watson (in charge of the works at Birmingham, England), in his paper read at the Fifteenth International Congress on Hygiene and Demography in Washington, that it is given herewith:

"One word with regard to management. However well a plant may be designed, if it is not well and skilfully managed it will become a nuisance and bring discredit to the engineer who designed it. The disposal of the liquid filth of a great community has an enormous potentiality for evil, and if a town authority believes it necessary to avert this by expending large sums of money on constructural work, it is their bounden duty to see that the plant is placed in the most competent hands. Local authorities are by no means sufficiently alive to this aspect of the question, with the result that too many works are left to the management of untrained men. Hitherto, anybody has been deemed good enough to look after a sewage work, but the day has now come when the manager should be a highly trained technical expert, if a local authority hope to get full value out of the sensitive entity which we call a bacteria bed."

Laboratory Control. The operation of a sewage treatment works is usually controlled by laboratory observations.

The methods generally used are largely adapted from the sanitary examination of water, and in many ways this work could be simplified.

What the operating engineer needs to know is whether each part of the works is being operated at its maximum efficiency and whether the final effluent is suitable for discharge into the stream to maintain the standard set for that stream. For purposes of comparison with other cities

more complete analyses are often desired of the crude sewage and of effluents. For instance, in the operation of a grit chamber the only important observation is the percentage of the dry residue which is organic, for if it is too high the velocity of flow through the grit chamber should be increased.

In the operation of a percolating filter it is most important to know whether the filter is delivering a stable effluent, and the storage and unloading of the suspended matter.

The most important facts required on sewage or effluent are the amount of settling material contained, the avidity for oxygen, and possibly the prevalence of pathogenic organisms.

The methylene blue test for stability marked a considerable advance, but even this has its limitations owing to the need of more extended data. Perhaps if natural conditions could be more nearly imitated the results would be more valuable. Small sample bottles, incubated air tight, afford quite different conditions from those existing in a normal stream with its constant absorption of oxygen from the air and the addition of oxygen liberated from green plants in the water.

Tests which show the results of the biological activity in the exhaustion of available oxygen in the sample tell more clearly the fitness for an effluent to be discharged than the quantitative chemical analyses of the sample.

Recommendations of topics for future committee investigation and suggestions of subjects for discussion at this meeting, appended.

GEORGE S. WEBSTER, *Chairman*,
FRANK A. BARBOUR,
GEORGE A. JOHNSON,
F. HERBERT SNOW,
J. L. LUDLOW,
LANDGON PEARSE,

RECOMMENDATIONS.

The Council, in appointing this committee, asked that it should make recommendations for special fields for committee work.

In accordance therewith, it is recommended that a joint committee of the vital statistics Section and the Sanitary Engineering Section, be appointed to make investigations and report upon the effect upon the death-rate attributable to the introduction of a system of sewers.

Also the relative efficiency in the protection of the public health by the filtration of water and by the treatment of sewage as measured by the death-rate from water-borne diseases.

That a joint committee of the Laboratory Section and the Sanitary Engineering Section be appointed to make investigations and report upon

standard methods for the operation and supervision of sewage disposal works.

Suggestions for Discussion.

Your committee suggests for discussion the following subjects, all of which are dealt with more or less in detail in the body of this report:

1. The importance of constructing sewers with smooth interior surfaces and of sufficient gradients to maintain self-cleansing velocities.
2. The advisability of the omission of the house trap on sewer connections.
3. The regulation of trade wastes which may be injurious to the sewer system and add to the cost of operating sewage treatment works.
4. The importance of so constructing sewers and house connections with tight joints to exclude ground-water infiltration.
5. The need for experts in planning and operating sewer systems and treatment works.
6. Simplified or improved laboratory methods for the control of sewage treatment works.
7. The economic balance between the water purification plant and the sewage treatment works.
8. The minimum oxygen content allowable in a stream or body of water, (1) to avoid nuisance and (2) to support fish life.

DISCUSSION.

Charles V. Chapin, *Superintendent of Health, Providence, R. I.*

It seems to me that in the matter of oyster pollution every case must be studied by itself and decided on its own merits. I am inclined to think that the danger from this source has been considerably exaggerated but I am heartily in favor of official supervision of all oyster beds and the forbidding of shipments from beds dangerously polluted if a reasonable standard can be determined upon. Many oysters from polluted waters have in past years been consumed in Providence but I have been unable to determine after a careful consideration of the data that this has had any influence on the incidence of typhoid fever in this city. I believe that sewage can be disinfected so as to destroy the pathogenic bacteria which are to be feared in this connection and I think that all sewage discharged over oyster beds ought to be so disinfected. This is what is being done with the Providence sewage amounting to over 20,000,000 gallons a day.

I certainly do not think that fresh night soil ought to be used on crops which are likely to be eaten raw. If the night soil is dried and bagged it is very possible that by the time it reaches the soil all pathogens will be dead. I do not think this method of disposal should be condemned without further investigation. Such investigation is very desirable.

H. C. McRae, *Division Engineer, Baltimore Sewerage Commission.*

A considerable amount of thought, some of which has been expressed in print, has been given recently to the subject of analytical procedure in connection with the operation of sewage treatment plants. It is encouraging that some effort is being made to break away from the effect of tradition along these lines. It took a long time for sewage analysts to leave behind

the determination of albuminoid ammonia which had proved so valuable in the examination of potable waters, and it is seemingly taking a long time to leave behind certain other tests bequeathed by water experts. The investigators at Columbus spent a great amount of time and energy in collecting engineering data which seemed to them important at the time. Investigators later at Boston, Baltimore, Philadelphia, Gloversville, and other places, followed in the groove, probably, for the most part, because they were afraid to get out of it. Tables showing analyses of nitrogen in all forms, oxygen consumed, and suspended matter, in all stages of treatment, look well in reports, but, after all, are they worth the effort necessary when an attempt is made to use them for guidance in operating a plant? It is, no doubt, wise to continue the collection of such data as far as raw sewage is concerned for the purpose of comparison between different localities, but, as far as operation is concerned, the time seems ripe to discard them for the most part and devote the time saved to studies of stability, oxygen conditions at various stages, and particularly the condition of streams and lakes into which effluents are discharged and the effect of effluents on such water bodies. In the last analysis the effect on a stream or lake is the important thing. The study of these is, therefore, as important, if not more so, than the study of the effluents themselves. If laboratory practice is to keep pace with progress in other phases of sewage treatment, this fact must be recognized and acted on quickly.

The need for technically trained men to operate sewage treatment plants is so positive that to discuss it seems almost like discussing the axiom that a straight line is the shortest distance between two points, but, unfortunately, history has shown that authorities responsible for many plants, particularly those of moderate size, have often been content to let the plants virtually run themselves; or, in other words, have entrusted their operation to ignorant and even careless attendants. Such procedure has resulted in nullifying much effort and thought on the part of sanitarians by bringing the science of sewage treatment in bad repute with the laity who naturally are influenced by results rather than by theoretical considerations in the minds of designers. It is of great importance, therefore, that all who are interested in this subject should not lose any opportunities to further the chances of successful operation of treatment plants by bringing about a condition whereby competent, trained men will be placed in charge.

A sewage treatment plant to an operating engineer is much like a sick man to a physician. The appearance of the sewage, filter beds and effluent to the eye, the odors characteristic of certain conditions, the organic life present at various stages and the facts shown by analytical procedure are symptoms indicative of conditions just as the appearance of a man's features, the feel of his pulse, his temperature, the analysis of his urine or a microscopical examination of his blood are signs by which the physician can form an estimate of his condition and from which he can reason logically and decide intelligently as to ways and means to alleviate it.

A man with the proper training to bring forth the ability and desire to learn the symptoms and to prescribe properly has an even chance of making a plant accomplish the intent of the designer, while one who simply goes through the motion of opening and shutting valves is almost sure to make a mess of things, unless favored by an unusually kind Providence.

As previously suggested, it is usually the case of small plants that the hesitancy to spend a proper amount of money in order to obtain competent operators is most pronounced. To better conditions in this regard, it would seem that some sort of central control body should have jurisdiction over such plants with powers to enforce the employment of proper men, placing, if necessary, a number of plants under the control of one man. Such an arrangement would make it possible for large enough salaries to be paid to attract the proper quality of men, and only when this result is accomplished will the intent and painstaking work of designers cease to be nullified by ignorance and neglect.

MARSHALL R. PUGH, *Philadelphia, Pa.*

The eminent degree of common sense displayed in this report, and the frank avowal of the necessity at times of falling short of theoretical perfection in order to attain practicable results, are calculated to have a great influence for good.

The statements about velocity of flow are noteworthy. Many communities have been put to much additional expense both for added costs of construction and maintenance costs for operating pumps, simply because a 2-foot per second velocity of flow was regarded by the engineer as not merely desirable, but as absolutely essential. To cite but one instance out of many: The original cost of a proposed system was reduced 40 per cent. and maintenance nearly 99 per cent., and a gravity flow obtained, simply by substituting a flow velocity of 1.1 feet per second for that of 2 feet per second. Had not this been done, the community could not have met the added initial expense, and the cost of operating a pumping plant. The result of years of successful operation has justified the choice. A velocity of flow as low as 0.7 feet per second in a 10-inch terra-cotta sewer has worked well for a decade, and saved another municipality the cost of pumping for a low-lying district during all that period. The flushing cost has been less than $50 during the same length of time.

Under "Ventilation" the report will greatly strengthen the position of those who, like the writer, have frequently been in a losing struggle in opposing house traps. One borough was induced in 1904 to pass an ordinance which, after providing for the extension of the soil pipe, "4 inches in diameter, which must extend full size at least one foot above the roof," further said, "There shall be no traps or catch basins placed in the line between the house and the sewer in the street." Doubtless others had similar regulations before this, as numbers have had more recently; but the vast majority insisted on traps.

The elimination of ground water might have been even more forcibly touched on, without over statement of its importance. In a collecting system composed of terra-cotta pipes, the sewage from which must be treated, tight joints are essential, and if the sewer is in wet ground, tightness may spell the difference between the success and failure of the sytsem. Under such conditions cement joints are not to be thought of, but some bituminous material should be substituted.

Several trade products, in which the joints are poured like the lead joints in water pipe, are excellent if properly applied and if the ditch can be kept free from water while the pouring is done. The claims made for successful pouring when either entirely or partially under water have never been proved to the writer's satisfaction. When the ditch cannot be kept *entirely* free from water, a joint of Carolina tar, kneaded into a stiff dough with cement, forms probably the tightest and most satisfactory joint yet known. The objection to its use lies in the fact that as it is forced into the pipe by hand, no amount of inspection can insure good workmanship. The only salvation lies in employing a careful and conscientious caulker, in which case no difficulty will ensue. The tar contains from 5 per cent. to 30 per cent. of moisture, which the cement abstracts, thus setting and hardening. The chief function of the cement, however, lies in the fact that it is the most finely ground and uniform aggregate that is commercially available for kneading into the tar. Joints of this material thirty years old have been exposed by the writer recently, and found to be as tight and sound as when first laid. Settlement of the sewer does not impair bituminous joints, which are sufficiently yielding to permit quite a large deflection and still remain water tight.

MASSACHUSETTS ASSOCIATION OF BOARDS OF HEALTH.

The quarterly meeting of the Massachusetts Association of Boards of Health was held in New Bedford on Thursday, October 9, by invitation of the New Bedford Board of Health. The morning was devoted to inspection in New Bedford. The members were escorted in automobiles to Padanaram where a clambake was served.

President Samuel H. Durgin presided. On motion the reading of the minutes of the previous meeting was dispensed with. Prof. William T. Sedgwick presented an interim report of the Committee on Revision of Constitutions. Copies of the proposed constitution were circulated. Upon the recommendation of the Executive Committee the following persons were elected to membership in the association:

Mr. Abner Morse, Canton Board of Health, Dr. D. S. Luce, Canton Board of Health, Dr. S. H. Stone, Secretary of the Association for the Relief and Control of Tuberculosis, Boston, Mr. James C. Clark, Wareham Board of Health, Mr. R. P. Borden, Fall River. Mayor C. S. Ashley of New Bedford delivered an address of welcome to the association.

The following paper was then read: "The New Intercepting Sewer System of New Bedford," by William F. Williams, C. E., Chief Engineer, Massachusetts State Harbor and Land Commission.

Prof. William T. Sedgwick addressed the association on the School for health officers recently established by Harvard University and the Institute of Technology jointly.

On motion duly seconded the thanks of the association were extended unanimously to the New Bedford Board of Health and to the gentlemen who had so kindly loaned their automobiles.

There being no further business, the meeting then adjourned.

BOOK REVIEWS.

Elements of Water Bacteriology. *By Samuel Cate Prescott and Charles-Edward Amory Winslow. Third Edition. Rewritten. 306 pp. with index and numerous tables. New York, John Wiley & Sons, Inc. 1913. $1.75.*

The contents of this excellent text-book are as follows: Chapter I, The Bacteria in Natural Waters. Chapter II, The Quantitative Bacteriological Examination of Water. Chapter III, The Interpretation of the Quantitative Bacteriological Examination. Chapter IV, Determination of the Number of Organisms Developing at the Body Temperature. Chapter V, The Isolation of Specific Pathogenes from Water. Chapter VI, The Colon Group of Bacilli and Methods for Their Isolation. Chapter VII, Significance of the Presence of the Colon Group in Water. Chapter VIII, Varieties of Colon Bacilli and Their Special Significance. Chapter IX, Other Intestinal Bacteria. Chapter X, The Significance and Applicability of the Bacteriological Examination. Chapter XI, Bacteriology of Sewage and Sewage Effluents. Chapter XII, Bacteriological examination of Shell-fish. Appendix.

It is five years since the second edition appeared. Since that time there has been important progress along many lines of sanitary bacteriology. Besides the new edition of the reports of the Committee on Standard Methods of the Laboratory Section of the American Public Health Association has been published. Not only has the book been revised in accordance with the present state of the science, but certain of the chapters have been rewritten.

Regarding the advisability of omitting the 20-degree count, the authors place themselves on record as opposing the practice, and, as in earlier editions, make their position plain.

Chapter V has been greatly expanded, and the reviewer finds that there are included all the reliable tests for special organisms. Naturally in a work on water bacteriology special attention has been paid to the isolation of B. coli and allied forms. The subject is well and judicially handled and the conclusions are those accepted by bacteriologists in general. It does seem, however, that the authors' statement that all bacteria which will ferment lactose-bile are objectionable may have to be modified as the knowledge of organisms, and especially ground water organisms, becomes wider.

Chapter XII on shell-fish is new with this edition and discusses in a very practical way the bacteriological methods for the sanitary grading of shell-fish and contains an interesting discussion of the relation between shell-fish and disease.

As a text-book, the work is ideal. The subject matter of the book is presented in a logical sequence and the usefulness of the book is greatly enhanced by the excellent English style of the text. The reviewer did not detect any errors and the only omission noted was the name of the country in which the river Isar is located. The publication is primarily a text-book and the principles elucidated are explained at every turn by concrete examples from practice. The book abounds in references which are grouped in the Appendix in form for ready reference. In the Appendix are also given the methods for the preparation of the various culture media.

This book can be most highly recommended and should be in the library of everyone who wishes to become acquainted with the methods of bacteriological water examination and the interpretation of the results.

R. S. Weston.

Epidemic Cerebrospinal Meningitis. *By Abraham Sophian, M. D., Formerly of the Research Laboratory, Department of Health, City of New York. Cloth, 4°., pp. 261. Illustrated. $3.00. St. Louis, C. V. Mosby Co. 1913.*

It is a pleasure to review a book on cerebrospinal meningitis by one who has done so large an amount of original investigation in this field, as Doctor Sophian. Unlike many present-day writers, this monograph is not a mere collection of statements collected from the writings of others. What data have been collected from the literature are invariably combined with a well-reasoned analysis which leaves the reader in no doubt as to the author's belief or disbelief in their correctness.

The book is divided into six chapters dealing respectively with etiology, symptomatology, laboratory diagnosis of meningitis, complications, studies on blood pressure in meningitis, and, finally, treatment. Of the 261 pages making up the book, one hundred are devoted to treatment. Owing to the excellence of the entire work, it is difficult to pick out any one particular part of this monograph for special commendation. For those called upon to treat the disease, however, a careful study of the chapter on blood pressure and the chapter on treatment will prove invaluable. In fact, it is generally realized now that injections of the specific serum should always be controlled by observations in blood pressure in order to avoid risk of sudden death which otherwise sometimes follow such injections.

The book is well illustrated with photographs and drawings which add greatly to the value of the work.

Charles F. Bolduan, M. D.

Vaccine and Serum Therapy, Including also a Study of Infections, Theories of Immunity, Specific Diagnosis and Chemotherapy. *By Edwin Henry Schorer, B. S., M. D., Dr. P. H. Second Revised Edition, 4°, 300 pp. $3.00. St. Louis, C. V. Mosley Co., 1913.*

Rearranged, much enlarged and thoroughly revised, the present edition is in every way far superior to the first. Following a brief introductory account of infection and immunity the author makes a strong plea for adequate specific diagnosis as a prerequisite to specific therapy. Then comes an excellent description of various methods of identifying the cause of an infection and here are discussed microscopical examination of stained preparations, cultural methods, determination by presence or absence of specific antibodies, anaphylactic reactions, chemical and empirical tests, etc. The reviewer was surprised to find no mention of Friedberger's interesting work on anaphylotoxin or of Vaughan's studies on proteid split products. A discussion of immuno-therapeutics in general is followed by a chapter devoted to the specific diagnosis, treatment and prophylaxis of individual infections. The book is well written, the material well chosen, and the advice given practical and scientifically sound. Let us hope that the book will be widely read, especially by the many slipshod practitioners who by the employment of "shot-gun" injections of bacterial vaccines think to counteract careless habits in arriving at a correct diagnosis. The work may confidently be recommended to physicians and health officers desiring a general survey of an important branch of modern medicine.

Charles F. Bolduan, M. D.

Parasitology, A Laboratory Guide to the Study of Parasitology. *By W. B. Herms, Assistant Professor of Applied Parasitology, University of California. New York, Macmillan, 1913. 15 + 72 pp. 8 vo. $0.80 net.*

The importance of animal parasites in the causation of disease is becoming more and more impressed upon both physicians and sanitarians. It is, therefore, with particular pleasure that we welcome this first American text-book designed as an aid to the study of

parasites in the laboratory. The book is an outline of work intended to occupy the student during a full college course of three lectures a week and two laboratory sessions of two and a half to three hours each throughout the academic year. Most of the work is to be done with prepared material, which must be considerable in amount, representing a large number of species.

The book is divided into an introduction and three parts. In the introduction is given a brief synopsis of the general principles of parasitology, which is continued in the introductory portion of Part I, entitled "Medical Entomology." The first four exercises of Part I are on the general anatomy of insects, with especial emphasis on the mouth parts. Most of this part is devoted to the study of various species of parasitic insects and arachnids. The last three exercises take up the protozoa. The forms studied are the Amoebae, the Trypanosomes, and the Malarial Parasites—one exercise for each of these groups.

Part II is on "Helminthology," and includes exercises in the study of round worms, leeches, flukes, and tapeworms, with one exercise in diagnosis by detection of eggs in feces, and one exercise on larval insects that occur as internal parasites.

Perhaps the most interesting and valuable part of the course is Part III, in which directions are given for the study of the life history of the house fly, the mosquito, and the flea. Although the work is outlined as three numbered exercises, it is not intended to be completed in three laboratory periods. The student is expected to collect the living material early in the year, to keep the specimens alive in the breeding cages, and to make and record observations on them in addition to his other work throughout the year.

On first examining the book, one cannot but feel a sense of disappointment that the treatment of the Protozoa is so meagre. Certainly one would expect one exercise at least on that very important group, the Coccidia. On the other hand, the treatment of the insects and worms is full and adequate, and one cannot do everything in a single college course.

Undoubtedly the book will be a great aid and stimulus to the teaching of parasitology; and if some enterprising naturalist can be induced to prepare and offer for sale series of preparations to be used in this connection, the very considerable difficulty of conducting such a course will be rendered much less formidable.

R. P. Bigelow.

The Modern Treatment of Nervous and Mental Diseases. *Edited by William A. White, M. D., and Smith Ely Jelliffe, A. M., M. D., Vol. II. Lea & Febiger, Philadelphia, 1913. $6.00.*

The second volume of this excellent work admirably sets forth the opinions of both American and European authorities upon nervous and mental disturbances. To give a short review of all chapters would require much more space than is appropriate, so it has been deemed advisable to refer only to those articles which especially involve social, school or mental hygiene.

Dr. I. Abrahamson in Chapter III on the "Treatment of Muscular Atrophies and Dystrophies," suggests that, since the etiology of these conditions is not known, careful investigation into both endogenous and exogneous factors is paramount. The hereditary trait consists of a predisposition to certain diseases induced by disturbances in the metabolism, by blood disease, by various intoxications and other constitutional aberrations which possess in common a selective affinity for the nervous system, that is, an acquired tendency. Secondly there is an increased vulnerability of certain organs due to germinal anomalies of this inherited tendency. He urges prophylaxis in combating the neuropathic taint, first by the regulation of marriage, second by the prevention of conception and third by hygienic measures in tainted families.

Doctor Munson in Chapter IV on the

"Treatment of Epilepsy" has covered the subject in a concise manner. He meets the situation from all sides and advocates institutional treatment for all epileptics. The recent cases can be cared for with a possibility of cure. The chronic cases should be housed and labored. The non-productive cases, idiots and imbeciles, should be placed in institutions purely for custodial care. This segregation then limits the fitness to marry and in some states the limitation has been further extended to sterilization as a positive side for non-productiveness.

In the chapter on "Syphilitic Disease of the Nervous System," by Doctor Jelliffe, he states that nearly all forms of adult syphilis of the nervous system can be encountered in hereditary syphilis. He refers to cases of feeble-mindedness, hydrocephalus, ependymitis, Freidreich's ataxia, primary optic atrophy, different encephalitides, juvenile paresis and tabes dorsalis, as being cases encountered in hereditary syphilis. He refers in a short space to the element of sex and its relation to the present generation, and suggests what might be done by raising the standard of moral prophylaxis.

Doctor Scripture's chapter on "Stuttering" brings forth many factors exceedingly helpful to teachers and educators, in connection with the care and treatment of stutterers. He not only associates stuttering with physical causes, but also with physical factors, and offers in treatment psychotheraphy as well as re-education.

This work has been clearly written. The various writers have given their material in a clean-cut and forcible manner; the material has been carefully organized by the editors and brought up to date by every particular. It is a work not only for the specialist but also for the general practitioner.

Frederic J. Farnell, Providence, R. I.

Applied Bacteriology for Nurses. *By Charles F. Bolduan, M. D., Assistant to the General Medical Officer, Department of Health, City of New York, and Marie Grund, M. D., Bacteriologist, Department of Health, City of New York. 12mo of 166 pp. Illustrated. Philadelphia and London: W. B. Saunders Company, 1913. Cloth, $1.25 net.*

This book is divided into two sections, one dealing with the fundamental principles and the other with more specialized bacteriology. In the first section the authors outline the various methods for the study and cultivation of bacteria, the action of disinfectants and methods of sterilization. There is also a brief discussion of the paths of infection and immunity. Under the head of Special Bacteriology the authors, in short chapters, give a résumé of the more common diseases. They include the most common means of infection, the symptoms, and the methods to be used to prevent further spread of the disease. The part played by milk and water is also introduced.

As is stated in the preface the application to nursing is the important part and every thing is made to point toward that as an end. Its value lies in the distinct concise statement of facts. This makes it very useful in the hands of one who has only a limited time for the study of the subject. Throughout the book there are many helpful illustrations.

Ruth Bryant.

HEALTH DEPARTMENT REPORTS AND NOTES.

TO STATE AND MUNICIPAL HEALTH OFFICERS.

This new division of the Journal is specially designed to be of use to active Health Officers of the countries represented in the American Public Health Association. It will be unable to serve its true function unless the Health Officers are willing to coöperate by sending to the Journal copies of their reports, bulletins, new ordinances and personal information which will be of general interest. Furthermore it would be distinctly desirable if communications on subjects of general interest are submitted for publication in this division of the Journal. The management will further welcome any suggestions from Health Officers for the improvement of this division. All communications should be addressed to Selskar M. Gunn, Managing Editor, American Journal of Public Health, 755 Boylston St., Boston, Mass.

REPORTS.

Winnipeg, Manitoba

This year, as in previous years, we find the report of the Department of Public Health of Winnipeg among the best of all those received by the JOURNAL. It is a volume of 172 pages, well printed and illustrated with numerous full page half-tone engravings, illustrating typically good or bad conditions, and with charts and tables, well chosen and easily understood. It approaches the ideal inasmuch as it serves not only as a complete but concise report of the work accomplished, but also as a means of education in sanitary matters and a kind of sanitary survey of existing conditions for the benefit of the citizens of Winnipeg, and by its reports of methods used and its recommendations for future activities it has an especial interest to those who are interested in public health work in other localities.

Winnipeg is a city of about 166,000 population and while it is in general quite new and up-to-date it naturally is not perfect. While the expenditures of the Department of Public Health are omitted from the report, they are apparently high as indicated by the list of forty-five members of the official staff. The term "high" must not be considered as being used relative to the results obtained. A death-rate of 13.4 per 1,000 is reported. The birth-rate was 30.2 and the infant mortality rate, 199.5 per 1,000 births. Dr. A. J. Douglas, the medical health officer, points to this last figure as being altogether too high and proposes to take immediate and energetic steps to lower it.

The first thirty-four pages of the report are taken up by the report of Dr. Douglas who summarizes the other reports bringing out the more important features. Among the notable features of the work during the past may be mentioned the reduction of the tuberculosis death-rate from 123.6 per 100,000 population in 1910, when the work was started, to 94.2 in 1912; the tracing and suppression of a milk-borne typhoid epidemic of ninety-two cases; the installation of two new incinerators for refuse disposal; the listing by streets of all privies in the city to aid in plans for sewer extensions; education of

the people by means of a monthly health bulletin, special newspaper articles, moving picture shows on sanitary subjects which have been seen by thousands and have done much to popularize the work, inauguration of a Little Mother's League in the schools, and by addresses before various gatherings; practical assistance to dairymen and restaurants by supplying free plans of modern sanitary construction.

Among suggestions for improvement in the future are: increased facilities for laboratory work; the addition of a child welfare division to the department with the employment of additional nurses and the inauguration of an educational campaign; the establishment of a dental clinic for school children; additional provision for the hospitalization of cases of contagious disease, and more stringent regulation in regard to reporting disease; the purchase of new and sanitary equipment for the collection of refuse; the promulgation of various laws, recommendations for many of which have been submitted in detail. These include the obligatory pasteurization of all non-tubeculin tested milk, the more thorough inspection of meat, the complete reconstruction of the Tenement House Law; and increased regulations for undertaking establishments and for maternity homes.

Worcester, Massachusetts

While the annual report of Worcester for the year 1912 is a small and unpretentious affair for a city of 160,000, the results reported indicate that the Board of Health is carrying on active and efficient work. The death-rate, excluding deaths at the State Hospital for the insane, is 14.33 per thousand, a rate slightly higher than that for 1911 but lower than the average for the past ten years. The rate of deaths of infants under one year of age to total births is 129.2 per thousand.

The tabular arrangement of statistics is clear and instructive in general, although it might better be rearranged, omitting some parts which are duplicated or unimportant, and introducing or enlarging upon certain features which are slighted. The international system for the classification of deaths is used.

During the year of 1912 a school nurse was employed for the first time and has accomplished a great deal. School physicians are also employed and carry out regular inspections. They also report the vaccination of 2,748 children during the school year. The chief needs of the health department at the present time is more imspectors, a scarlet fever ward in the isolation hospital and an additional city nurse. Plans have already been completed and the appropriations made for a new incinerator and for a tuberculosis hospital which will be completed during the present year.

Harrisburg, Pennsylvania.

The Board of Health of Harrisburg, a city of about 67,000 population, presents its report for the year 1912. The president of the Board states that many greatly needed improvements are prevented by lack of money. Among the needs which he mentions are the following: annual census of the city, to be taken by the police; two additional assistants to the health officer; legislation and inspection which shall lead to improvements in food supplies and housing conditions; a new municipal hospital for infectious diseases; increased facilities for bacteriological diagnosis of disease; a remodeling of the present system of garbage disposal, for which two thirds of the whole appropriation for health work was expended during the past year. He also complains of the lack of laws which are able to handle existing conditions and of the criminal negligence of many of the physicians in regard to reporting contagious disease and advising quarantine.

The death-rate for 1912 was 14.18 per thousand, the birth-rate 19.85, and the death-rate for children under one year was 118 per thousand births; 1,250 cases of measles were reported during an epidemic which lasted through the spring.

DEPARTMENT NOTES.

Barber Shop Sanitation.

"Barber shop sanitation was accorded its proper attention in January, 1912, when the Department of Health employed a trained man, on full time, to look after this work. Mr. Patron, have you noted the results?

"One may have a reasonable sense of security when he rests his head on the freshly sterilized linen or the paper towels which most of the proprietors are supplying.

"Barbers are required to sterilize the razor blade before shaving a customer and after stropping. A germicidal solution of trikresol may be found in most shops; other shops depend upon boiling water. Some of the better shops are installing apparatus for the sterilization of all instruments. Notify the Health Department if your barber fails to sterilize the blade before he shaves you.

"Hot running water is one of the requirements in the barber shop regulations. Many makeshift devices were 'good enough' when inspection was begun. Barbers are required to cleanse shaving mugs and brushes in hot water before and after use.

"Before barber shop inspection was instituted there was a temptation to use a common sponge first on one man, and then on the other, without the intervention of sterilization. An individual cup in some places only gave a false sense of security. Sponges are forbidden and so is the powder puff—that medium for the friendly interchange of transmissible skin diseases.

"A few years ago it was not uncommon to have one towel for several patrons. Note the change the next time you 'get a shave.' See how many clean towels are used on you alone.

"The department requires that styptics used to stop the flow of blood after accidental cuts, be in powdered or liquid (consequently individual) form. No longer can the barber reach into his pocket and rub into your open cut a foul germ-laden piece of alum.

"No person suffering from venereal disease or other communicable disease shall act as barber.

"The Health Department is doing its best to protect the public against diseases which may be acquired in barber shops. With few exceptions proprietors are heartily in sympathy with the movement.

"Inspections are made once a month. As an expression of appreciation of the good efforts and results obtained the department issues to each shop owner a certificate giving the rating of his place. A man who has a Class AA shop will want the public 'to be in on the secret.' He will put the same in a conspicuous place. Does your barber show such a certificate?"

Weekly Report of the Board of Health of Cincinnati, Ohio, November 15, 1913.

Sanitary Standards for Bakeries.

Adopted by the National Association for Master Bakers.

"1. Building well lighted in every part with natural light, and thoroughly ventilated; air supply free from contamination by surface dust.

"2. Floors, wall and ceiling of impervious materials with smooth surfaces and kept clean. Rooms kept free from vermin and screened against flies.

"3. Plumbing, drainage, etc., ample to remove waste and prevent dampness, and kept in good order. Sanitary toilets, shut off entirely from bakeshops and storage rooms.

"4. A plentiful supply of pure water, convenient and adequate washstands and supplies.

"5. Garbage, refuse, etc., stored in tightly covered cans and disposed of quickly.

"6. Machinery, tools and other equipment so made, installed and used as to facilitate cleanliness and safety.

"7. Stables so located and kept disinfected as to prevent odors from same reaching bakery.

"8. Methods of distribution such as to

protect bakery products from contamination between the oven and the home.

"9. A health certificate showing freedom of all employees from skin diseases, tuberculosis, venereal and other contagious diseases. Spitting and the use of tobacco in the bakery prohibited.

"10. Employees of bakeries should be properly clothed in clean, sanitary clothing."

Bulletin Chicago School of Sanitary Instruction, November 8, 1913.

The Overcrowded Street Car.

"The over-filled street car is a great American menace. In Louisville on some lines, especially during the 'rush' hours, human beings are packed closer than the humane society would allow anyone to pack creatures who lack immortal souls. A street car crowded to its greatest capacity, all the seats occupied, the aisles jammed with people clinging to straps, swaying against each other, many of them coughing and sneezing, is exceedingly dangerous to the public health. Under such conditions the air breathed is filthy and germ laden, from diseased throats and lungs, and head colds in active stages. One or two small ventilators, even if always open, are not sufficient.

"All that is necessary to improve this condition is to put more cars on during the rush hours, and allow only a certain number of passengers to each car. They should not be allowed to stand in the aisles. In most of the cities of Europe, the street cars are plainly marked with the seating capacity of the car. When the car contains this number of passengers, no more are taken. If European city governments have fully and effectively succeeded in regulating their street car accommodations, why cannot we do it in Louisville?"

Health and Hygiene Department of Health, Louisville, Ky., November 1, 1913.

A Diploma Now Required of Midwives.

"While it is undoubtedly true that the standard required of midwives is higher at present than it was several years ago, before the Department of Health took an active interest in its elevation, it must be confessed that the standard in this city left a good deal to be desired, and was much lower than that in many European countries. With the object of remedying this deficiency, the department has decided that in future it will require the presentation of a diploma or certificate showing that the prospective midwife is a graduate of a midwifery school before a permit to practice will be issued to her. The resolution embodying this intention was passed at a meeting of the board of health on the 14th day of October, 1913, and reads as follows:

"Resolved, That the rules governing the practice of midwifery in the city of New York, adopted by the board of health, November 8, 1907, be and the same hereby are amended, so as to read as follows; the same to take effect on and after the 1st day of January, 1914:

"Rule 3. The applicant must be twenty-one years of age or upwards, of good moral character, and able to read and write. She must be clean and constantly show evidence in general appearance, of habits of cleanliness.

"The applicant must also present a diploma or certificate showing that she is a graduate of a school for midwives registered by the Board of Health of the city of New York as maintaining a satisfactory standard of preparation, instruction and course of study, but the requirement of a diploma shall not apply to any person who is now or heretofore has been authorized to practice midwifery by the said board."

Weekly Bulletin of the Department of Health of the City of New York, October 25, 1913.

The Importance of Keeping Hands Clean.

"Probably the commonest way in which infections are implanted within our bodies is from hand to mouth.

"Our hands are more or less constantly coming in contact with infectious matter and they are more or less constantly going to our mouths; if not into them, they handle and infect the things which we put into them.

"It is, therefore, intensely important that we shall always keep our hands as clean as possible by frequent washing.

"Hand washing is necessary:

"*Immediately* before eating.

"*Immediately* before handling foodstuffs, in course of preparation or serving.

"*Immediately* after necessary toilet attentions.

"*Immediately* after handling the sick or articles from a sick room.

"*Immediately* after handling any dirty article.

"Persons charged with the preparation or handling of foodstuffs and those engaged in the care of the sick should be especially careful about their hands. A cook with dirty hands is liable to infect every person who eats the foods she handles. A nurse with infected hands can readily spread disease.

"In washing give special attention to the cleansing of the spaces under the fingernails. Use lots of soap, warm water and a good hard bristle brush.

"Keep your hands clean and you will avoid many unnecessary infections.

"Look to your cook's hands—that's a test of her efficiency and of your safety at her hands.

"Immediately dismiss a nurse who is careless about the condition of her hands.

"These are simple, every-day matters—but they count mightily. Dirty hands will hand you trouble."

Bulletin, Chicago School of Sanitary Instruction, November 1, 1913.

Control of Disease in New York Schools.

"The modern conception of the transmission of infectious diseases has led to certain modifications in the attitude of the Department of Health in regard to its methods of dealing with these diseases in reference to the schools.

"Cases of scarlet fever are excluded from school for at least five weeks, or until desquamation is complete and all purulent discharges have ceased. If quarantine is observed by the family, children and others who have had the disease may return to school. If children or other members of the family, who have not had scarlet fever, are immediately removed to another address, they may return to school at the end of five days, if, in the meantime, they do not develop the disease, but they must present a special school certificate issued by the department. If they continue to reside at home, they cannot return to school until the case of scarlet fever has been officially discharged by the Department of Health.

"In the case of measles, the patient is excluded from school until five days after the appearance of the rash, at which time, if he is otherwise well and all catarrhal discharges have ceased and the cough has disappeared, he may return. Children, and other members of the family who have had the disease, may continue in school provided that quarantine at home is properly observed. Children or other members of the family who have not had the disease, and are immediately removed to another residence, may return to school at the end of fourteen days, the usual limit of the period of incubation, upon presentation of a special school certificate issued by the Department of Health; if continuing to reside at home they must not be readmitted until the case has been officially discharged by the Department of Health.

"Children suffering from German measles are excluded for one week, at the end of which time they must be seen by a school medical inspector and will be readmitted on his certificate. Other members of the family who have not had the disease, are excluded until the school medical inspector recommends their readmission. Children in the family who have had the disease may remain in school.

"Children suffering from chickenpox are excluded from school until all scabs have disappeared at which time the child must be seen by a school medical inspector and readmitted on his certificate. All other children of the family who have not had the disease are excluded until the school medical inspector recommends their readmission. Children in the family who have had the disease may remain in school.

"Children suffering from whooping-cough are excluded from school until the whoop has entirely disappeared, which, generally speaking, means from six weeks to two

months. In public, parochial and all other free schools, a child must be seen by the school medical inspector and be readmitted upon his certificate. In private schools, the child may be readmitted on the certificate of his own physician. In either case the child must be again excluded if the characteristic whoop should recur.

"Children suffering from mumps are excluded until the swelling has entirely subsided. In public, parochial and other free schools, the child must be seen by the school medical inspector and be readmitted upon his certificate. In private schools, the child may be readmitted on the certificate of its own physician. All children of the family who have not had the disease are excluded until the school medical inspector recommends readmission. Children in the family who have had the disease, may remain in school.

"Children suffering from diphtheria are excluded for a minimum period of one week and must not be readmitted until all symptoms have disappeared and the culture is negative. A certificate from the Department of Health must be presented upon readmittance. If quarantine is observed, children and others who have been immunized against the disease and cultures from whose throats do not show diphtheria bacilli, may return to school. If children or others in the family are immediately removed to another address and culture taken from nose and throat is negative, they may be readmitted but must present a special school certificate issued by the Department. If continuing to reside at home and the above precautions are not taken, they cannot be readmitted until the case has been officially discharged by the Department of Health.

"When a teacher is a member of a family or household in which a contagious disease occurs, the teacher must be excluded, except that continuance at school may be permitted at the discretion of the department. A special certificate must be issued for this purpose."

Monthly Bulletin, New York City Department of Health, August, 1913.

Popularizing Registration of Births.

How to get complete vital statistics is a problem everywhere and although laws and penalties are necessary and to some extent beneficial it is probable that instruction of the public as to why such reports are necessary will probably accomplish much more permanent improvement. The *United States Public Health Report* for October 24 tells of how the Indiana Board of Health is working to get more complete registration of births.

"The Indiana State Board of Health is exerting itself to secure more accurate birth reports and has adopted a plan to bring the importance of birth registration before the women. The board has a traveling exhibit, passing from town to town, spending one week in each place. This public health exhibit consists of charts, diagrams, mottoes, pictures, maps, photographs, pathological specimens, etc. The exhibit is usually displayed in an empty storeroom with banners across the street to attract attention. The coming of the exhibit is announced in the schools and churches, and advertised in the local papers two weeks ahead. The exhibit is under the charge of two men who do nothing else. They carry a stereopticon, showing both still and moving pictures, and give illustrated lectures twice a day. The schools are visited, the pupils receive special instructions in general hygiene, the teachers and school authorities are assembled, and the social clubs of the town join in the work.

"Dr. Hurty, secretary of the State Board of Health, states that the special feature adopted this year is to arouse an interest among the women in birth registration by offering a prize to the young married women who will present the most names of other women promising to talk up the necessities and advantages of accurate birth registration. The prize which will be offered is a year's subscription to the *Mothers' Magazine*.

"The Indiana State Board of Health is preparing a Mothers' Baby Book. It will be bound in cloth, and treats simply and briefly of the care of the baby. This book will be sent to every mother when her first

child is born, together with a letter of congratulation from the board. The letter will have something to say regarding registration, and will, therefore, advance that particular feature."

The Toothbrush as an Infection Carrier.

While the article which recently appeared in certain of the sensational newspapers advocating the use of sterile water for brushing the teeth in order to avoid introducing bacteria into the mouth seemed rather ridiculous to sanitarians; we now find the Chicago Board of Health advocating the sterilization of the toothbrush after each use. It cannot be denied that the average toothbrush is far from clean but it is perhaps better worth while to bend our energies toward the popularization of the toothbrush among the masses rather than its sterilization among the classes. The following article, clipped from the *Bulletin of the Chicago School of Sanitary Instruction*, however, points out some of the possible dangers attending the use of the toothbrush without proper safeguards:

"A case of diphtheria recently reported from a Chicago orphanage has resulted in observations and laboratory investigations which point to the toothbrush as a possible carrier and spreader of infections, especially in children's institutions, including schools, where the practice of tooth washing—toothbrush drill—entails the hanging of scores of brushes side by side in the intervals between use. While disinfecting the orphanage in question, our quarantine officer, a graduated dentist, had his attention drawn to a long row of toothbrushes arranged in a numbered rack attached to the walls of the lavatory immediately above the battery of wash bowls. Upon close inspection of these toothbrushes it was observed that some were filthy, the bristles being choked with débris, mostly organic matter in the nature of strings of meat. It was immediately recognized that brushes in this condition would be natural incubators for disease germs and in view of the close proximity of the brushes and the possibilities of contact and the danger of exchange by the users, it was seen that they might be active disseminators of disease.

"With this suspicion in mind the quarantine officer ascertained the number of the brush which had been used by the diphtheritic inmate of the orphanage and from this made a number of cultures. The laboratory findings positively indicated the presence of the diphtheria bacilli in large numbers in this brush. Unfortunately all other brushes on the rack were subjected to sterilization before further culturing was done.

"For school or institutional use a simple and inexpensive outfit could be made from a glass test-tube about one inch in diameter and seven inches long. Place cotton (for saturation) in the bottom of the tube and fit a tight cork into the open end of tube. The brush may be placed in the tube, the bristles in contact with formalin-saturated cotton, or it may be suspended from a hook attached to the inner end of the cork.

"On removal of a brush from these formalin containers, rinse it well with cold water and before replacing it in the container give it another thorough washing.

"Brushes so kept will not only be sterile but will have a refreshing odor and will retain a desired firmness of the bristles for a longer period of time.

"Another advantage which suggests itself in this treatment of the brushes is that a little formaldehyde, a tissue hardener, may be retained in the brush and applied with benefit to the soft, sensitive gums of those who suffer from pyorrhea alveolaris, a disease which causes teeth to loosen."

Typhoid Fever in New York during the First Six Months of 1913.

During the first six months of 1913, the reports of the Department of Health of the city of New York show that New York City was remarkably free from typhoid fever; more so, in fact, than during any previous semi-annual period. This is shown in the following table:

First six months of year.	Cases reported	Deaths.
1908	792	169
1911	762	148
1912	897	169
1913	467	91
Five year average, 1908-1912	824	167

"The figures for 1913, as shown above, are not only relatively but absolutely less than those for any corresponding period since the incorporation of the greater city, and, in view of the steadily increasing population, the relative comparisons become even more marked. Thus, in 1908, there were eighteen cases per 100,000 of the population; in 1912, 17.6 cases, and in 1913 only 8.8 cases. It is probable that a number of favorable influences have contributed to this notable decrease. In the first half of 1913 there were fewer out-of-town infections and fewer secondary infections from the cases occurring in the city. The latter circumstance is partially accounted for by the anti-typhoid immunizations which, since the beginning of the year, have been performed by the department upon persons exposed to the disease.

"It can hardly be doubted that the improved quality of New York City's milk supply, due in great measure to the pasteurization enforced by the department's regulations, has been prominent among the local factors causing the favorable showing in the total decrease of cases. From the fact that the cases originating in the city were not localized at any time to a single district or districts, it would seem that few, if any, could be attributed to an infected water supply. The educational campaign so persistently pursued by the department for the past several years is undoubtedly producing results. The general public have a better understanding of the proper method of handling typhoid cases occuring in their homes, and some of the press comments on the work of the department have undoubtedly aided, by instructing people generally in regard to the prevention of infectious diseases. It must, of course, be admitted that the number of cases of typhoid fever may again increase in number, and we must never lose sight of the fact that it is not wise to draw too hastily deductions to our own advantage from seeming cause and effect, but the figures given above are certainly cause for congratulation so far as they go."

New York Medical Journal, October 4, 1913.

Measles Pointers.

The public does not generally understand the true danger which accompanies a case of measles and the unfortunate custom of exposing a child to the disease in order "to have it over with" still exists in too many localities. The following pointers from the *Texas Board of Health Bulletin* are worth repeating:

"Measles is an extremely contagious disease and among infants it is highly fatal.

"Ninety-five out of every hundred deaths from measles are among children under five years of age.

"It is the height of absurdity to expose a child to measles so that 'it may have it and get over it.'

"Measles frequently terminates fatally—bronchial-pneumonia being among the commonest and most fatal complications.

" 'Black measles' is the malignant type of the disease and very fatal. The blackish color is due to hemorrhages in the skin.

"The contagion is thought to be present in the particles of mucus in the secretions of the mouth and nose.

"It develops in from seven to eighteen days after exposure, usually fourteen.

"The disease is especially contagious before the eruption appears.

"A 'feverish cold,' sneezing, running at the nose, cough, and red, watery eyes are the early symptoms.

"These symptoms increase until the third or fourth day, when a rash appears.

"Immediately isolate a child showing symptoms of measles—the earlier the better.

"A measles case must be kept in quarantine until the temperature remains normal for forty-eight hours.

"Children exposed to measles, who have not had the disease, must be isolated—kept entirely away from other children—for a period of two weeks after last exposure.

"All articles coming from a measles patient room must be sterilized.

"If your child 'seems to have caught cold' after measles, look out for tuberculosis. Consult your doctor."

Sanitary Survey of Cambridge, Mass.

The sanitary survey habit is spreading rapidly and Cambridge, Mass., proposes to survey itself. Although most cities would obtain better results by calling in the assistance of experts especially trained in this work, such as those of the Russell Sage Foundation, with such a man as Professor Whipple to head its commission Cambridge may expect excellent results. The following note is clipped from *The American City* of November.

"From Harvard comes the announcement that Mayor J. Edward Barry has appointed two of the University professors as members of the Sanitary Commission of Cambridge. The commission now comprises: chairman, George C. Whipple, Professor of Sanitary Engineering, Harvard University; secretary, Dr. B. J. Peirce, Medical Inspector, Board of Health; James Ford, Professor of Social Ethics, Harvard University; Lewis M. Hastings, City Engineer; Edwin W. Quinn, Superintendent of Streets.

"That the commission has very important work ahead of it is indicated by the following outline of its objects:

" 'To undertake a comprehensive investigation of the sanitary conditions of the city of Cambridge, to ascertain the relations between them and the health and physical comfort of the people. To this end it is proposed: First, to enlist the coöperation of the various city departments, and of such existing associations as are already considering particular phases of the problems; second, to undertake such original studies as may be necessary; third, to conduct a campaign of public interest in municipal cleanliness, especially in those sections of the city where the population is most dense; fourth, to recommend to the city government from time to time such sanitary improvements as seem desirable; fifth, to publish ultimately the results of the findings of the commission as a matter of historical interest.' "

Sterilization of Bathing Suits.

"During the summer a business was established opposite the municipal baths at Coney Island for the purpose of hiring out bathing suits to bathers, and it developed that the Department of Health, under section 26 of the Sanitary Code, which relates to bathing beaches, could not enforce the proper sterilization of these suits. Section 26 was, therefore, amended at a meeting of the Board of Health, held October 28, 1913, in order to remedy this defect. The entire resolution is lengthy and it hardly seems necessary to quote it in full. The amendment adds that 'bathing suits shall not be hired out . . . without a permit in writing from the Board of Health and subject to the conditions thereof.' "

Weekly Bulletin of the Department of Health of the City of New York, November 1, 1913.

Manure Production.

The September number of the *Department of Public Safety* of Rochester, N. Y., contains the following rather interesting figures on manure production and its relation to the fly problem. It is almost enough to make one give up hope and conclude that the automobile is the only solution.

"There are 15,000 horses in the city. It is not necessary to inquire what the average intake of each horse amounts to, but the average output consists of thirty pounds of manure and eight pints of urine per day. It means that the 15,000 horses deposit on the streets and in the stables of Rochester over 82,000 tons of manure annually. Now, a three-ton load of manure occupies a space 14 x 4 x 5 feet; hence the total manure output of the city would make a pile covering an acre of ground 175 feet high. If every pound of manure exposed furnished a breeding place for 100 flies, then we would have as a result of this large pile of manure 16,400,000,000 flies. To show that this quantity of manure per animal is not excessive, we have verified our estimate and find that one large concern in the city with 200 horses has about 1,200 tons of manure to dispose of annually.

"The meaning of these figures is intended to convey to our minds the fact that we can no longer rely upon the slogan 'Swat the Fly,' that to get rid of the fly we must starve it. All manure and sweepings and other wastes must be carefully housed. All food, and

everything upon which the fly can possibly breed or feed must be covered. Fly traps must be baited and cared for especially at this time of year when some of the remaining flies get into winter quarters and furnish enormous progeny for the next year. Every fly must be swatted; but more than all else, we must clean up so that there is nothing upon which the fly may feed; no decaying material in which to lay its eggs. 'Starve the Fly' must be the new slogan."

Elimination of Raw Milk from Grade B.

"Holding that the protection of the public health now requires that all milk used in New York City, except certified milk and similar special grades, should be either pasteurized or brought to the boiling point before it is consumed, the board of health at its last meeting adopted a resolution forbidding the sale of any raw milk for consumption on the premises, and amended the Sanitary Code and the rules and regulations for the sale of milk to remove from Grade B the class of raw milk which was formerly permitted to be sold under that designation. The effect of this amendment of the milk regulations, which takes effect February 1, 1914, is to limit the sale of raw milk in New York City to milk which conforms to the requirements of Grade A. Only milk produced under exceptionally stringent requirements as to cleanliness can now be sold in the raw state.

"The requirement relating to the sale of milk for consumption on the premises, which is to take effect immediately, is a matter which particularly concerns the patrons of restaurants, hotels and lunch counters as well as the proprietors of these places. Hereafter when a glass of milk is purchased at a restaurant, hotel, lunch counter, milk booth or any similar place the purchaser may know that the law requires that this milk should be pasteurized unless it is Grade A milk. This grade includes certified milk, guaranteed milk and inspected milk which has been pasteurized.

"A study of the cases of typhoid fever which occurred east of Broadway and south of 40th Street during September indicated to the department beyond any reasonable doubt that a certain supply of Grade B raw milk was the means of transmitting the infection in a large number of the cases, and raw milk has, therefore, been eliminated from Grade B. This action should be considered as the latest step in the execution of a carefully developed program under which the Department of Health for the last four years has endeavored gradually to bring about the pasteurization of the entire supply of general market milk of New York City. Commissioner Lederle has repeatedly expressed the opinion that under the present conditions of production and consumption of the milk supply of New York City, the only means of insuring safety from the transmission of infection while keeping down the price of milk was to adopt the requirement of pasteurization on a large scale. By the adoption of the grading system and by increasingly stringent regulations the department in the last four years has been able to to raise the proportion of pasteurized milk to the total supply of New York City from 7 per cent. to 75 per cent. At the present time, out of a total average daily supply of 2,000,000 quarts of liquid milk, it is estimated by the department that an average of 1,500,000 quarts is pasteurized. The adoption of the latest regulation requiring the pasteurization of all except the highest special grades of milk (which constitute an almost negligible percentage of the total supply) will mean that practically all milk sold in the city after February 1, 1914, must be pasteurized."

Weekly Bulletin of the Department of Health of the City of New York, November 8, 1913.

PUBLIC HEALTH NOTES.

The Cure of Typhoid Carriers.

"A prize of £500 has been offered by an anonymous donor to be awarded without distinction of nationality to the person who discovers a cure for chronic typhoid carriers. Papers must be written in German and addressed, before 1st October, 1914, to Prof. von Schjerning, president of the Competition Committee, 86, Wilhelmstrasse, Berlin. The committee is composed of Profs. Ehrlich, Gaffky, Kraps, Uhlenhuth, and Hoffman. Experimental work must be described in detail, so that it can be immediately controlled."

The Medical Officer, September 27, 1913.

Use of Ultra-Violet Rays.

"At Marommes les Rouen, a suburb of Rouen, France, a large public water supply with an output of 100,000 gallons of water a day, is being purified by means of ultra-violet rays. The plant has been installed for nearly three years and is said to have been operated with complete success.

"The water is first filtered through sand and the ultra-violet rays apparatus sterilizes the water at the rate of 100,000 gallons per day by means of a single one-horse-power lamp."

The American City, December, 1913.

And This the Twentieth Century?

"It is reported that a leper was brought from the West in a box car in order to be deported, and that when he left the car at the port of sailing, the car was burned. And yet leprosy in this country has not a fraction of the infective power that tuberculosis has. What would one think of burning a box car because a consumptive had ridden in it? It is the unusual that we fear, which shows that we are not so much different from the primitive savages. We can sleep in peace when typhoid fever (which kills one hundred thousand to one of leprosy in this country) is right under our noses. We hardly take interest in the fact, which has been proved, that typhoid carriers are in our dairies and in our restaurants, and we do not even successfully prevent the access of typhoid flies to our dining-tables; and if a member of the family departs by the typhoid route, it is taken as a matter of course and soon forgotten. Yes, we may even eat raw oysters from beds not above suspicion of typhoid contamination; but if a leper rides in a box car, *burn it!*"

Life and Health, December, 1913.

Railway Sanitation.

"The advance of the railways of the country in applied sanitation has been marked. When one recalls the conditions allowed to exist in railway cars twenty years ago the present state of cleanliness is comparatively satisfactory. The railways are, indeed, to be commended for their gradual introduction of hygienic regulations that keep their cars, in spite of the numbers of people who travel in them every day, in a state that is not likely to endanger health. There remains, however, one phase of railway sanitation that will soon have to be dealt with. Though it is a difficult phase, there is no doubt that improvement of present conditions must come without delay. It would seem to be better for the railways to take up the problem of their own initiative rather than be forced into it by legal regulation. This is the present mode of disposing of the sewage of trains. In former years when population was less dense and when trains were not nearly so frequent and crowded, it was perhaps not so much to be deprecated that the railways should scatter sewage over the right of way. Now that railways cross thickly populated tracts of territory, and express trains pass through towns of considerable size without stopping, the crude disregard of hygiene in this matter is entirely out of keeping with present-day sanitary science, particularly as the railway rule is to have the toilets locked only during the times of stopping at stations, which gives opportunity for the

scattering of offensive material, distinctly dangerous to health, even on the streets of towns. Railways frequently cross streams that are connected with water supplies, and the present custom may well prove a source of contamination of drinking water. Now that we are carefully disposing of sewage in connection with our cities and are no longer allowing ordinary water ways to be contaminated as formerly, protection of our smaller streams will surely come to be felt as a necessity."

International Hospital Record, August 20, 1913.

Rural Sanitation.

Although public health work is growing rapidly in popularity it is too largely confined to cities, at least in the United States. Rural districts, although perhaps normally more healthful, suffer from their ignorance of sanitary matters. *American Medicine* (October, 1913) reviews an article from the *Medical Review of Reviews* which deals with this subject. We quote the review entire:

"H. N. Ogden calls attention to the fact that the diseases in the rural population are not chiefly the contagious diseases which form so conspicuous an item in the general death-rate of the country at large.

"As there is no congestion in the population of the rural districts there is slight tendency to the spreading of disease. On the other hand, the high death rates are from lung diseases, influenza, liver and kidney disease and constitutional disorders in general. Efforts in rural sanitation should, therefore, be directed to the education of the farmer in matters relating to personal hygiene. There are no restrictions in the country as to the sanitation of buildings and grounds, such as obtain in cities. Consequently improvement in hygiene must come from instruction rather than from authority, and health officials should, therefore, improve every opportunity to teach sanitary laws. Many health officers may reply that they are not hired to do work as teachers. If this is true it means that their particular departments of health are badly organized and require reconstruction.

"The following suggestions are offered as indicating hopeful lines of work:

"(1) The granges of the state offer the most attractive possibilities in this direction and a health officer could find pleasant and useful employment at their meetings.

"(2) There should be coöperation with the rural school superintendents and discussion of sanitary matters in the various school houses.

"(3) Instruction may be given to the children of the country schools by their teachers after the latter have been properly posted by the health officer on the subjects upon which they should be informed.

"(4) The health officer can occasionally work with the pastor of the rural church, addressing the people on sanitary matters, on suitable occasions, at the church.

"In all these points the department of health is only in line with the tendencies of the times when it attempts to give to rural inhabitants the same advantages with regard to public sanitation which are enjoyed by the cities."

Personelle of Health Boards.

Too often the members of a board of health are elected because they are "well-intentioned respectable citizens" rather than because of any peculiar qualifications for the position. The suggestion that insurance agents should make the most practical health workers may not appeal to all, but certainly more thought should be used in selecting members than is usually the case. The *Engineering Record* of November 8 discusses the subject from the engineers' standpoint:

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waists, a man of leisure, a newspaper humorist, and the one doctor upon whose presence the law insists. And the one doctor, as it happens, is an eye and throat specialist, so his knowledge of and interest in preventive medicine as related to municipalities must be in inverse ratio to his proficiency along his own line. These selections, at once so absurd and so outrageous, have been received in New Rochelle with perfect equanimity by a great majority of the inhabitants. Only a minute and ineffectual minority deems the matter worthy of comment. The rest, if questioned on the subject, seem surprised that anybody should be interested in it, and, if pressed for an expression of opinion, say, 'Oh, the commissioners are all respectable citizens, honest, well-intentioned, and good neighbors.' So they are. It is not the intention here to cast any reflections upon them as individuals, or upon their several businesses as such. But what imaginable connection have the virtues mentioned with the protecting of a city from disease, with the drafting and enforcing of sanitary ordinances? Not even echo has any reply to make; so one can safely assume that there is none.' While this vigorous expression is much to be commended, one cannot but inquire whether subsequent cogitation would lead the *Times* to the realization that even a board composed entirely of physicians would not be wholly satisfactory. Municipal sanitation is not a problem of 'preventive medicine.' It is primarily engineering. Purity of water supply, disposal of sewage, collection and disposal of garbage, street cleaning, tenement-house sanitation—these are the main problems affecting the well-being of citizens. No board of health is properly organized unless its engineering representation is strong. To say that the board can employ engineers is only to put up the strawman so often and easily disposed of. The employed engineer is only an employee; the engineer on the board has equal authority with his colleagues. His judgment will be accepted as final where that of the employed engineer will be waved aside without a thought."

Boys for Sanitary Inspectors.

American Medicine for September comments editorially on a new method for keeping the streets clean:

"Using boys to keep the streets clean was the happy inspiration of Policeman Miller of New York City—all honor to him! He organized some street urchins into a sanitary squad of inspectors who reported to him any instances where peddlers or housewives threw rubbish into the streets. A few prosecutions convinced the culprits that health laws are serious matters, not fads of the finical. East Broadway, which was said to have been the dirtiest street in the world, is now the cleanest. Everyone knows that the easiest way to have clean streets is to prevent the dirt and yet the majority of city residents seems to think that the proper thing to do with small rubbish is to throw it into the streets. Shop keepers have been notorious offenders and do not hesitate to spread their sweepings on the sidewalks for the wind to scatter. We have long preached from the tent that we could not end the present customs of city savages, until we had convinced the best of them that their ways were wrong, and that the best way to reach them was through the children. Every child should be taught in school that cleanliness is next to godliness, and in a little time there would be good fruit. But this millerite idea of giving the boys large bright nickel badges as a sign of authorized inspectorship was nothing short of genius. Boys are essentially good—what goes for badness is generally a result of fun-loving propensities. They are emotional and can easily be won to any good cause, particularly if decorated with a badge and clothed with a wee bit of authority to flatter the self-esteem which so early manifests itself and which should be cultivated still more. Many a temptation to commit crime would be resisted if the boy had more self-respect. So we heartily approve this new movement, because it helps the boys as much as it helps sanitation. Indeed, everyone should be an inspector for we are all vitally interested in the future city beautiful. We wish all policemen would do as

scattering of offensive material, distinctly dangerous to health, even on the streets of towns. Railways frequently cross streams that are connected with water supplies, and the present custom may well prove a source of contamination of drinking water. Now that we are carefully disposing of sewage in connection with our cities and are no longer allowing ordinary water ways to be contaminated as formerly, protection of our smaller streams will surely come to be felt as a necessity."

International Hospital Record, August 20, 1913.

Rural Sanitation.

Although public health work is growing rapidly in popularity it is too largely confined to cities, at least in the United States. Rural districts, although perhaps normally more healthful, suffer from their ignorance of sanitary matters. *American Medicine* (October, 1913) reviews an article from the *Medical Review of Reviews* which deals with this subject. We quote the review entire:

"H. N. Ogden calls attention to the fact that the diseases in the rural population are not chiefly the contagious diseases which form so conspicuous an item in the general death-rate of the country at large.

"As there is no congestion in the population of the rural districts there is slight tendency to the spreading of disease. On the other hand, the high death rates are from lung diseases, influenza, liver and kidney disease and constitutional disorders in general. Efforts in rural sanitation should, therefore, be directed to the education of the farmer in matters relating to personal hygiene. There are no restrictions in the country as to the sanitation of buildings and grounds, such as obtain in cities. Consequently improvement in hygiene must come from instruction rather than from authority, and health officials should, therefore, improve every opportunity to teach sanitary laws. Many health officers may reply that they are not hired to do work as teachers. If this is true it means that their particular departments of health are badly organized and require reconstruction.

"The following suggestions are offered as indicating hopeful lines of work:

"(1) The granges of the state offer the most attractive possibilities in this direction and a health officer could find pleasant and useful employment at their meetings.

"(2) There should be coöperation with the rural school superintendents and discussion of sanitary matters in the various school houses.

"(3) Instruction may be given to the children of the country schools by their teachers after the latter have been properly posted by the health officer on the subjects upon which they should be informed.

"(4) The health officer can occasionally work with the pastor of the rural church, addressing the people on sanitary matters, on suitable occasions, at the church.

"In all these points the department of health is only in line with the tendencies of the times when it attempts to give to rural inhabitants the same advantages with regard to public sanitation which are enjoyed by the cities."

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Miller has done—and then perhaps the commissioners themselves might do something along this line. We must end the practice of throwing garbage, rubbish, papers or dirt of any kind into the streets, and then the problem of cleaning up the unavoidable filth will be easy. Let the fines be big enough to pay for the cleaning."

Anti-typhoid Vaccination.

An article originally published in the *Medical Record* for October 4 is reviewed as follows by the *New York Medical Journal*:

"A. H. Doty states that his intention is not to minimize the value of this form of treatment within reasonable limits and in the hands of those properly equipped to administer it, but rather to inquire into its range of usefulness and to suggest that we carefully consider its defects, as well as the protection it extends. Having pointed out the differences between this and vaccination for the prevention of smallpox, he says that the protection of soldiers and sailors against infectious disease is a responsibility which very properly rests with the medical officer in charge; furthermore these men are employed for the protection of the public, and must be prepared at any moment to deal with emergencies. In connection with this duty they are frequently transferred from one place to another, and may often be exposed to very bad sanitary conditions; therefore unusual or more extended means of safeguarding their health is justifiable. There are other emergencies in connection with outbreaks or anticipated outbreaks of typhoid fever, and also other conditions, where the vaccine may be useful. He does not believe its employment advisable, however, as a preventive measure in hospitals, stating that is it is depended upon, in some way relaxation will take place in the enforcement of the sanitary measures which are imperative in the care of typhoid. During the past year the public in various parts of the country, and particularly persons about to travel, have been officially advised to secure the benefits of the anti-typhoid vaccine, but he does not think a general recommendation of this kind proper or wise. Nor does he accept the statement that this means of prevention involves no risk, for it is generally conceded that any acute infectious or organic disease, or impaired health, contraindicates the use of this measure. Hence, those in charge of the public health should deal in the most cautious and conservative way in approving or recommending a serum or vaccine for general use. Doctor Doty believes that those who will give this subject careful consideration will be convinced that the employment of anti-typhoid vaccine as a preventive measure should be strictly confined to conditions or emergencies where it is deemed justifiable to carry out special means of protection. Under these circumstances unpleasant results may be avoided, and the public mind will not be disturbed, or its faith weakened in modern sanitary methods in which its coöperation is so urgently needed and which are so essential to the preservation of health."

Medical Inspection of Schools.

Dr. C. P. McCord, medical inspector of schools of Albany, N. Y., publishes an article the *Albany Medical Annals* for November on "Health Direction in Public Schools." In view of the rapidly growing interest in this phase of health work there will be many who will wish to read the whole article, of which only a small portion is quoted below:

"Medical inspection constitutes a specialty as much as laryngology or otology are specialties. The work has not found a place in the curricula of many of our best medical colleges, and I know of but two American medical colleges which offer courses on the diseases of children of school age and on social pediatrics. In view of the fact within the next few years several hundred cities will institute medical inspection, there would seem to be a need for well-trained young men along the line of this special work.

"The full-time man selected preferably should have had some experience as an executive in school work. This, with a first-class medical training, including a knowledge of the elements of the specialties, makes a happy combination. He should have a fair outlook upon pedagogical and sociological problems. He should know the 'special case'

child. The salary should be somewhere between $2,000 and $3,000 a year. There should be a sufficient number of nurses to assure a daily visit to every school (approximately one nurse to every 1,500 children). The inspector should have an office adjoining that of the superintendent of schools. Provision should be made for a system of adequate records if the work is to be placed from the start upon a scientific basis. A good working and reference library along medical, psychological and sociological lines must be gathered, and a few of the best magazines bearing upon these lines of science must come regularly to the office. These items must be considered when the question of appropriation for the work is up for discussion.

"The appropriation for the first year of such a system in a city of 100,000 should be at least $5,000, and this amount will furnish only the minimum number of nurses. It will be necessary to increase this sum from year to year as the number of nurses for the most efficient conduct of the work is approximated, and also to provide for any additional salaries, equipment, attendance upon conventions, etc., such as may be indicated under a system of health direction as outlined farther on in this paper. The board of education should secure the coöperation of the medical profession in any city in question."

Pellagra Insect-Borne?

The following review (from the *Medical Review of Reviews*, October 1913) of a paper on the mode of transmission of pellagra brings together in a concise form some facts which may be new to our readers and which may give rise to increased investigation and knowledge of one of our little understood diseases:

"Sambon advanced two propositions concerning the cause and nature of pellagra. (1) The hypothesis that it is an infectious disease, and (2) the hypothesis that it is an insect-borne disease. These have been widely accepted, though his third suggestion that the Simulium fly is the specific germ carrier is open to much discussion. This view is opposed by Robert (*American Journal Medical Sciences*, August, 1913), who believes that a mosquito is the carrying agent and offers the following as some of his reasons:

"Those equally confined within doors are equally infected, regardless of sex. The insect probably lives and bites in houses.

"In Italy, Roumania, and America, pellagra predominates in females and in those individuals who remain in and about the house all day. They are more exposed to the disease than those away from home.

"Like malaria and filariasis, pellagra is chiefly rural.

"Pellagra has an unquestioned relation to streams, swamp areas, standing water, and places where the mosquito breeds, as have malaria and yellow fever.

"In areas both malarial and pellagrous, rains and floods that increase malaria, also increase pellagra. With the proper drainage of such areas, both diseases decrease and later disappear.

"Malaria, yellow fever, filariasis, and pellagra all tend to cease spreading, the cases improve, and the disease disappears with the advent of frost, cold, and winter. All these diseases decline during the winter because of the influence of the cold season upon the development of the insect parasite.

"Pellagra, malaria, yellow fever and filariasis are non-contagious and non-inheritable.

"The incubation period in malaria is ten days to three weeks; in yellow fever, thirty-six hours to fourteen days; in pellagra, probably two or three weeks, certainly less than four weeks. This signifies kinship of insect carriers.

"Pellagra is absent from Ireland, where mosquitoes are relatively scarce.

"Malaria, yellow fever, filariasis and dengue are also absent from this land.

"Practically all pellagrous areas are malarial areas.

"Pellagra and malaria have latent periods and periods of activity, due to the change in the seasons, the fixed lifeperiod of the parasite, and its alternating periods of activity and rest; and to changes in climate, altitude and vitality.

"Pellagra, like malaria, yellow fever, filariasis and dengue, has its epidemics, its years of severity and mildness.

"Pellagra occurs in the same belt (north and south) as do all the other mosquito-borne diseases."

Publicity and Public Health.

An editorial in the *Medical Review of Reviews* for October discusses and urges publicity in public health work and points out its relation in this respect to medical science. It is a division of activity, the value of which can hardly be overestimated by health departments, but which is too commonly neglected especially in our smaller cities and towns. Work well done along the line of popular education offers, perhaps the largest returns for a small investment than in any other branch. We quote as follows:

"If the engineers who build bridges and dig canals do not talk much about their methods of work or tell the public about the technical progress of engineering, it does not greatly matter, for what the public wants is simply results—bridges and canals. The physician, in the light of modern preventive medicine, is a health engineer; but he cannot keep within his shell like his brethren in the other profession, because the results which he seeks—freedom of individuals from disease and better general health in the community — cannot be achieved except with the active coöperation of the individual men and women of the communities themselves. The people will not coöperate unless they understand something about the reasons for living according to this or that rule of hygiene, or following one or another regulation. To carry the simile a little farther, every man and woman is in a certain degree the engineer of his own health. The physician is the chief engineer, who is his guide; but the rank and file will not follow this chief like slaves or Japanese soldiers. They must understand what they are told to do and something of the reasons why.

"Modern medicine, progressing as it is more rapidly than almost any other present-day science, needs interpreters—we even dare say popularizers; but popularizers who are interpreters, men of a high order, who will do the kind of work which Huxley did for Darwinism. The physician, the modern engineer of public health, must take the public into his confidence and teach the public, as an educator, without fear of losing professional caste. In proportion as the public is thus taught and thus learns, it will support the medical profession in increasingly aggressive and effective campaigns for public health."

Mine Sanitation

American Medicine (September, 1913) reviews briefly as follows an article in the *Monthly Cyclopedia and Medical Bulletin*:

"N. P. Brooks considers his subject under the following headings:

"1. Ventilation. This subject has been carefully studied by mining engineers but not by sanitarians. It is thought that insufficient attention is given to the size and conditions of the air ways and their possibilities, from the standpoint of reduction of friction. No regard is paid to humidity, and very little to temperature.

"2. Drainage has received very little sanitary attention in general mine engineering.

"3. Disposal of excreta is beginning to arouse the interest of sanitarians but has not yet been applied to mining operations.

"4. Personal hygiene of the men has received very little attention in the United States and none in Mexico.

"5. Lighting has received attention from the study of explosions but none with regard to its effect upon the health of miners.

"Reserve work and first aid have been carefully considered in recent years, but an improvement in the sanitary conditions underground will be likely to develop a better and cleaner set of men and improve those who are already working.

"With this improvement will come less reckless disregard of life, fewer accidents and recognition and avoidance of dangers. The inculcation of bodily cleanliness will have a favorable effect upon the life of miners outside the pit.

"When common sense ideas of health and safety are insisted upon in mining, the same as in mill work, there will be more economical work and better workmanship

"No mine is an agreeable place to those who are unfamiliar with underground work, but any mine can be made as sanitary as the best mill.

"Operative risks will decrease as sanitation improves, but mining will always remain a hazardous occupation."

Malaria Mosquitoes.

The Tropical Diseases Bulletin gives the following review of an article which originally appeared in the *American Journal of Tropical Diseases and Preventive Medicine*, a new magazine published by the American Society of Tropical Medicine:

"The article—contains no new work and is intended to indicate certain lines of research which have been neglected in the past. After criticising the new systematic nomenclature of the old genus Anopheles, the author, confining himself to the American Anopheles, tabulates the valid species with their correct names. Out of the thirty-four mentioned the following eight have been definitely proved to be malaria carriers:

albimanus.	*quadrimaculatus.*
argyritarsis.	*pseudomaculipes.*
crucians.	*pseudopunctipennis.*
intermedium.	*tarsimaculata.*

"Attention is drawn to the fact that, in all probability, the same species of mosquito may behave differently towards the different species of malarial parasites, and work both in New Orleans and Formosa is cited in favor of this view. Thus *A. crucians* acts as the transmitter of æstivo-autumnal fever alone while *A. quadrimaculatus* does not convey this form but is efficient with benign tertian and quartan malaria.

"An interesting subject requiring further investigation is the relation of the habits of different species of Anopheles to malaria transmission. The frequency of blood meals increases the chances for acquiring the parasites. Hence the more voracious the mosquito the more likely is it to be a carrier of infection. Again 'domestic' Anopheles are more likely to be incriminated than those classed as 'wild.' Other phases of the study of Anopheles requiring attention are the relative longevity of different species and their local distribution as governed by topographic conditions. The author advances a plea for the prosecution of these and other investigations required for the proper control of the mosquito."

Hodgins Prize Award.

On the recommendation of the Committee on the Award of the Hodgins Prize of $1,500 for the best treatise "On the Relation of Atmospheric Air to Tuberculosis," which was offered by the Smithsonian Institution in connection with the International Congress on Tuberculosis, held in Washington in 1908, the Institution announces that the prize has been equally divided between Dr. Guy Hinsdale of Hot Springs, Va., for his paper on "Tuberculosis in Relation to Atmospheric Air," and Dr. S. Adolphus Knopf of New York City, for his treatise "On the Relation of Atmospheric Air to Tuberculosis."

The members of the Committee on Award were: Dr. William H. Welch, Johns Hopkins University, Baltimore, Md., chairman: Dr. Hermann M. Biggs, New York City, Prof. M. Davis, Cambridge, Mass., Dr. G. Dock, Washington University Medical School, St. Louis, Mo., Dr. Simon Flexner, Rockefeller Institute for Medical Research, New York City, Dr. John S. Fulton, Baltimore, Md., Brig.-Gen. George M. Sternberg, U. S. A. (Retired), Washington, D. C.

A. P. H. A. NOTES.

President Woodward appointed the following gentlemen as delegates of the American Public Health Association to the National Conservation Congress which was held in Washington, November 18, 19 and 20:

Dr. George M. Kober, Professor of Hygiene, Georgetown University, Washington, D. C.

Mr. Asa E. Phillips, Superintendent of Sewers, Washington, D. C.

Mr. David E. McComb, District Engineer of Bridges, Washington, D. C.

Dr. A. J. McLaughlin, United States Public Health Service, Washington, D. C.

Dr. Karl F. Kellerman, Bureau of Plant Industry, Department of Agriculture, Washington, D. C.

It has been decided that the next meeting of the Association which is to take place in Jacksonville, Fla., be held from November 24 to 28, inclusive.

One of the badges furnished for the American Public Health Association by the Local Committee in connection with the Havana meeting of 1911 has recently been picked up on the street in Washington, D. C. This particular badge is solid gold and was presumably prepared for presentation to one of the chief officers of the association at that time. The badge will be returned to the owner upon request and evidence of ownership. Apply to the Secretary. A. P. H. A.

Morrell Vrooman, for many years head of the Engineering Department of the city of Gloversville, and consulting engineer on questions of sewerage and water supply, will in the future devote his entire time to the engineering firm of Vrooman & Perry.

"In the retirement of Dr. Hermann M. Biggs as chief medical officer of its Department of Health, the city of New York sustains an incalculable loss, for to him, more than to any other individual, are largely due the extraordinary achievements of its public health work. Thanks mainly to Doctor Biggs's initiative, the discoveries in bacteriology in the eighties were used to work a revolution in the methods of public health administration in this city, thus placing this important work on a scientific foundation; and since then, through his tireless efforts, the medical work of the Health Department of the city of New York has constantly been kept abreast of the advances in scientific medicine. In fact, so keen an observer as Koch, on the occasion of his visit here in 1908, remarked that though so many important discoveries in medicine emanated from Germany, their practical application to public health work was more prompt and further advanced in this country. In particular, he mentioned the work done by the New York City Health Department in providing for the microscopical examination of sputum for tubercle bacilli, in examining cultures for diphtheria, in manufacturing and distributing free to the poor, diphtheria and tetanus antitoxin, and in examining blood for the Widal reaction. Since that time the Department of Health has begun the manufacture and distribution of bacterial vaccines, and, still more recently, aids physicians in the diagnosis of venereal infections by making free of charge Wassermann reactions for suspected syphilis and complement deviation tests for gonococcus infection.

"Not only with respect to laboratory work, moreover, has public health administration undergone a revolution. Following the intensive studies made as part of the tuberculosis campaign inaugurated in this city in 1892, attention was directed more and more to the social environment as a factor in public health, and in this feature of the work Doctor Biggs took a very active and leading part."

New York Medical Journal.

The Board of Trustees of the Drexel Institute of Art, Science and Industry of Philadelphia announce the election of Hollis Godfrey, Sc. D., as president of the Institute.

At the invitation of the American Road Builders' Association, President Woodward appointed the following committee to represent the association at the convention of the former organization, held in Philadelphia, December 9 to 12: Mr. Charles F. Mebus, Mr. George S. Webster, and Mr. John A. Vogleson.